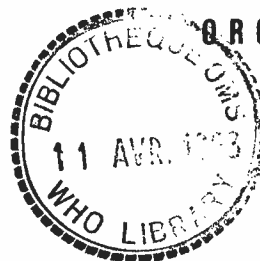


WORLD HEALTH
ORGANIZATION



ORGANISATION MONDIALE
DE LA SANTÉ

TWENTY-FIRST WORLD HEALTH ASSEMBLY

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Provisional agenda item 2.6

ORIGINAL: ENGLISH

SMALLPOX ERADICATION PROGRAMME

I. INTRODUCTION

An intensified programme of smallpox eradication, decided upon by the Nineteenth World Health Assembly,¹ commenced in January 1967. Funds were provided in the regular budget of the Organization; endemic countries were urged to take the necessary steps to begin eradication programmes as soon as possible; and multilateral and bilateral agencies were urged to provide material support.

The response on the part of the endemic countries has been gratifying. With assistance from the Organization and from multilateral and bilateral contributions, 15 of the 29 endemic countries commenced eradication programmes during 1967; it is expected that at least six more will begin programmes during 1968. Of 38 countries located in endemic regions but who do not have continuing endemic transmission of smallpox, 19 initiated or continued special vaccination and surveillance programmes during 1967; in at least nine others, such programmes are expected to begin in 1968.

This report,² requested in resolution WHA20.15, presents the current status of smallpox and eradication programme plans for 1968 and 1969.

II. STATUS OF SMALLPOX AND PROGRAMME DEVELOPMENT

The annual incidence of smallpox since 1959, according to the most recent information available to the Organization, is presented by continent and WHO Region in Tables 1 and 2. During 1967, 115 202 cases of smallpox were reported. This total is higher than any in the past decade with the exception of 1963. Although the most dramatic increase in cases was recorded in Asia, all endemic areas except Eastern and Southern Africa reported greater numbers of cases in 1967 than in 1966. The most notable increases in reported cases occurred in India which reported 80 174 cases in 1967, compared to 32 616 in 1966; in Pakistan, 10 621 in 1967 and 6142 in 1966; Brazil, 4335 and 3518; and Sierra Leone, 1638 and 293.

¹ Resolution WHA19.16, Handbook of Resolutions and Decisions, 9th ed., pp. 41-42

² The designations employed and the presentation of material in this report do not imply the expression of any opinion whatsoever on the part of the Director-General concerning the legal status of any country or territory or of its authorities, or concerning the delimitation of its frontiers.

TABLE 1. REPORTED SMALLPOX CASES BY CONTINENT 1959-1967

	1959	1960	1961	1962	1963	1964	1965	1966	1967
AFRICA									
North	41	7	8	1	-	-	-	-	-
West-Central	9 536	11 239	18 047	17 034	6 700	3 583	6 236	7 559	9 614
South-East	6 730	5 815	7 967	7 295	10 175	8 910	10 691	6 824	4 257
AMERICA									
North and Central	-	-	-	1	-	-	-	-	-
South	5 998	8 507	9 065	9 827	7 202	3 621	3 484	3 565	4 363
ASIA	71 310	39 844	53 960	63 692	98 790	43 546	39 191	50 295	96 963
EUROPE	15	47	24	136	129	-	1	71	5
OCEANIA	-	1	-	-	-	-	-	-	-
Total	93 630	65 460	89 071	97 986	122 996	59 660	59 603	68 314	115 202

TABLE 2. REPORTED SMALLPOX CASES BY WHO REGION 1964-1967

	1964	1965	1966	1967
Africa	12 389	16 869	14 103	13 398
Americas	3 621	3 484	3 565	4 363
Eastern Mediterranean	1 090	1 659	6 424	11 148
South-East Asia	42 560	37 590	44 146	86 288
Europe	-	1	71	5
Western Pacific	-	-	5	-
World total	59 660	59 603	68 314	115 202

Countries definitely or probably experiencing endemic disease, apart from sporadic introductions, include five in Asia, 23 in Africa and one in South America. At least 38 other countries may be regarded as being at special risk of smallpox introductions because of population movements and geographic proximity to endemic areas. Seven of these countries, in fact, experienced outbreaks during 1967. In none of these countries, however, did endemic smallpox become re-established. In addition, during 1967 and early 1968, eight introductions of smallpox occurred in five countries more distant from the endemic areas. The countries affected were Czechoslovakia, Federal Republic of Germany (two introductions), Kuwait, Trucial Oman (two introductions) and the United Kingdom of Great Britain and Northern Ireland (two introductions). In the five European outbreaks the first introduced case (index case) was promptly diagnosed and isolated, and contacts were vaccinated; no spread occurred except for a single case in the United Kingdom of Great Britain and Northern Ireland. In Trucial Oman, 10 cases were recorded and, in Kuwait 41 cases, before the outbreaks were brought under control. All importations into these countries resulted from infections acquired in India or West Pakistan.

FIG. 1
SMALLPOX CASES PER 100 000 POPULATION - 1966

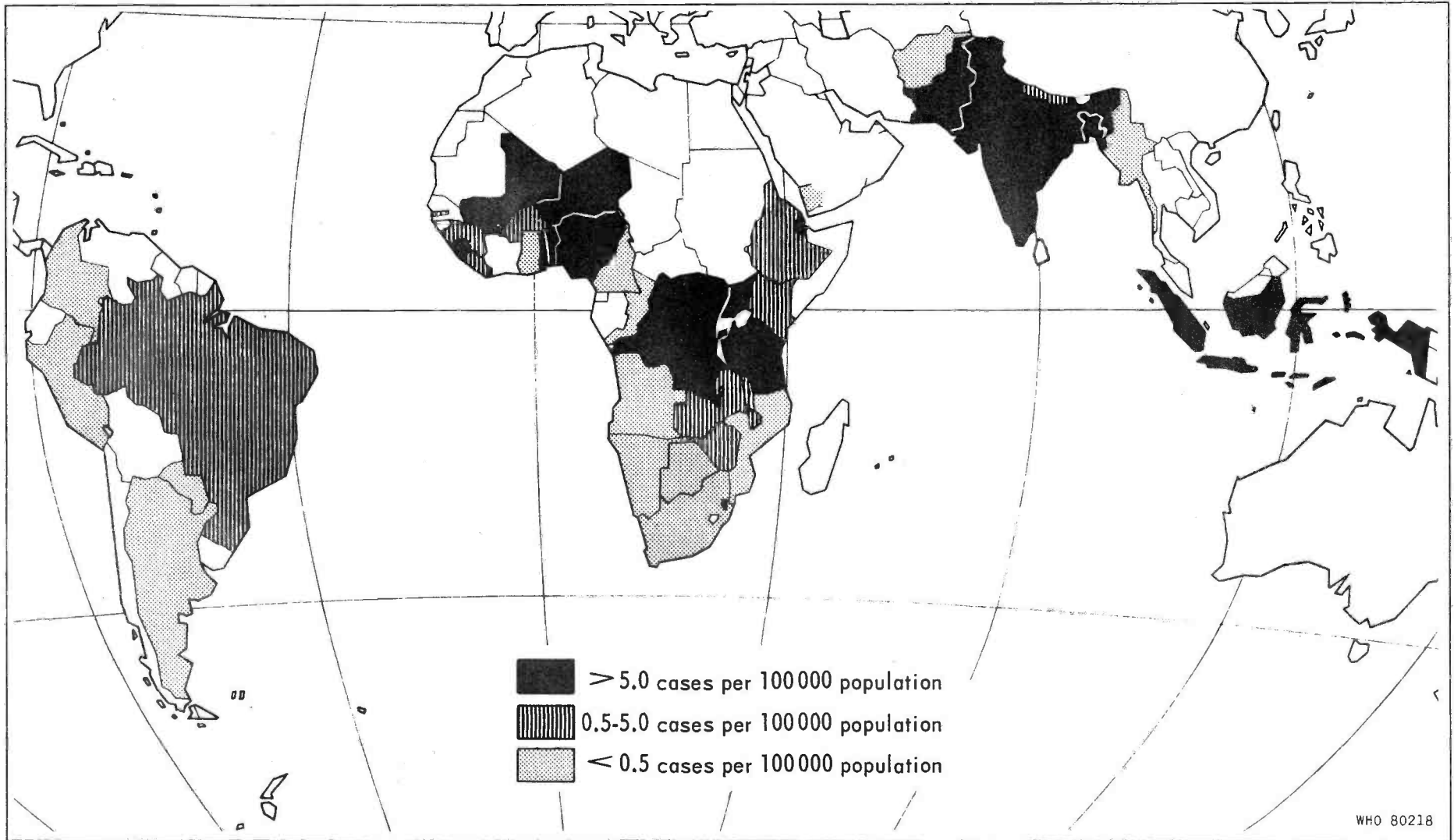
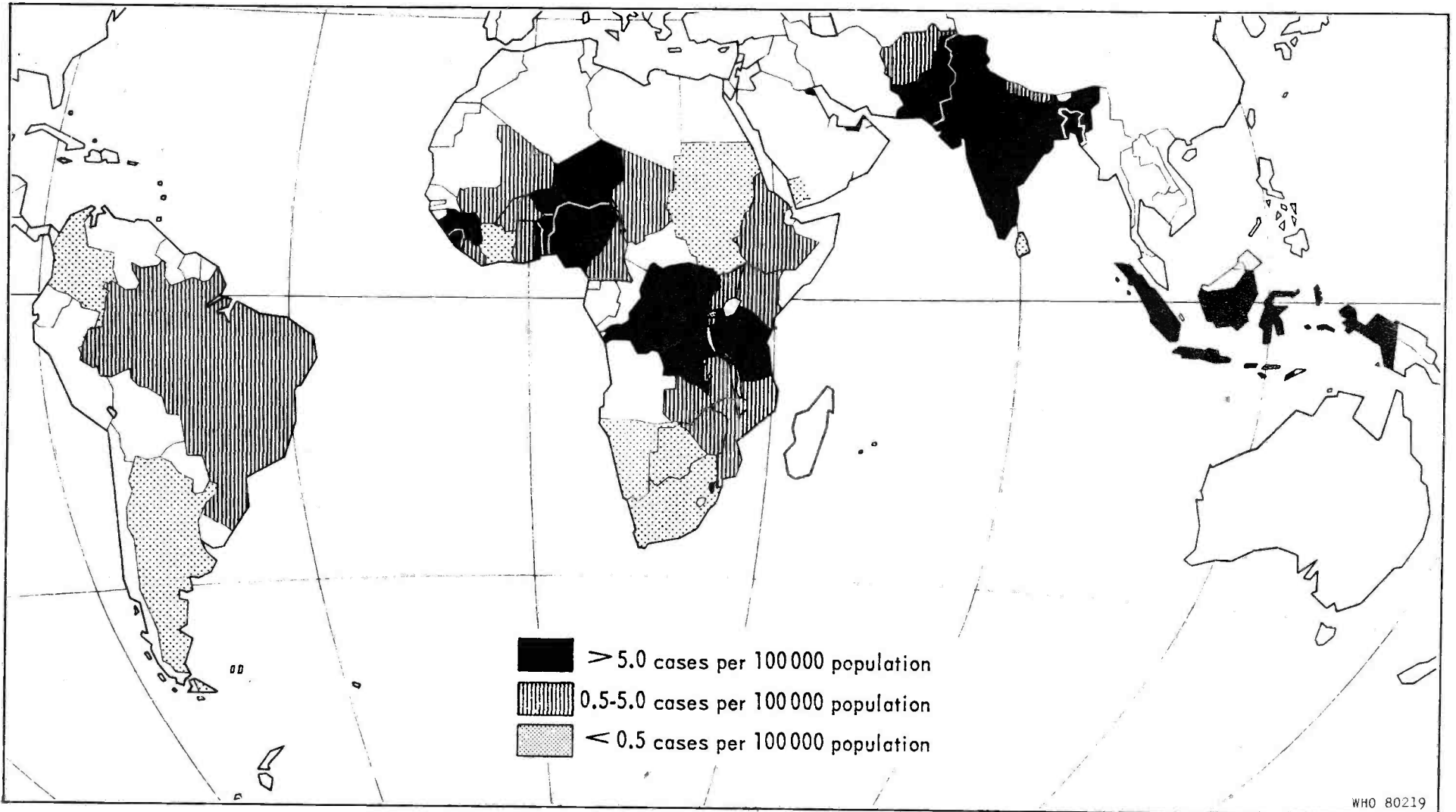


FIG. 2
SMALLPOX CASES PER 100 000 POPULATION - 1967



A comparison of the maps (Figs, 1 and 2) and Table 3, depicting smallpox incidence during 1966 and 1967 reveals comparatively few changes. Fourteen countries reported 5.0 or more cases of smallpox per 100 000 population during 1966 and 11 countries during 1967. The decrease in rates below 5.0 per 100 000 in Burundi, Mali, Swaziland and Uganda may reflect in part, increased vaccination and containment activities, as well as a natural decline in smallpox incidence due to normal cyclical variation of the disease.

TABLE 3. COUNTRIES AND TERRITORIES REPORTING MORE THAN 5.0 CASES/100 000 - 1966, 1967* - RATES PER 100 000

	1966	1967
Burundi	12.96	2.49
Congo, Democratic Republic of	12.50	8.94
Dahomey	23.04	34.82
Guinea	1.63	10.51
India	6.82	15.76
Indonesia	11.05	5.32
Mali	6.26	3.45
Niger	35.43	33.39
Nigeria	8.73	7.94
Pakistan	6.07	9.91
Sierra Leone	13.08	68.91
Swaziland	10.07	2.56
Togo	12.41	15.35
Uganda	8.02	4.61
United Republic of Tanzania	30.30	14.23

* In 1966 the French Territory of the Afars and Issas and, in 1967 Trucial Oman and Kuwait reported rates in excess of 5.0/100 000 as a result of brief outbreaks of introduced smallpox.

1. Africa

1.1 Smallpox incidence

Smallpox continues to be widespread although irregularly distributed throughout Africa south of Sahara. Three countries, Dahomey, Niger and Sierra Leone, experienced, during 1967, the highest rates of smallpox recorded anywhere in the world; many countries, on the other hand, record only sporadic cases resulting from disease importations. Because of extensive migration and travel throughout Africa, all countries are at high risk of smallpox introductions.

In the Western and Central African countries, an increased incidence of smallpox was observed (Table 4, Fig. 3). During 1967, 9614 cases were recorded, compared to 7559 cases during 1966. This increase can, in part be attributed to more complete case recording coincident with the development of eradication programmes throughout this part of Africa. In Eastern and South African countries (Table 5, Fig. 4), a slight over-all decline in cases was observed in 1967. Two-thirds of all cases in this area were recorded in the Democratic Republic of the Congo and in the United Republic of Tanzania.

TABLE 4. AFRICA (WEST AND CENTRAL)
SMALLPOX INCIDENCE AND PROGRAMME ACTIVITIES IN SMALLPOX ENDEMIC
AND NEIGHBOURING COUNTRIES AND TERRITORIES

Country or Territory	Population* (millions)	Smallpox cases reported				Eradication ^(X) activities	
		1964	1965	1966	1967	1967	1968
Cameroon	5.5	72	-	3	60	X	X
Central African Republic	1.4	-	-	-	-	X	X
Chad	3.4	5	73	-	86	X	X
Congo (Republic of)	0.9	198	89	2	-	X	X
Dahomey	2.5	718	168	530	875	X	X
Equatorial Guinea	0.3	-	-	-	-	XX	XX
Gabon	0.5	49	1	-	-	X	X
Gambia	0.3	6	6	3	-	X	X
Ghana	8.2	9	7	13	108	X	X
Guinea	3.7	320	69	56	387	X	X
Ivory Coast	4.0	11	8	-	2	X	X
Liberia	1.1	258	40	32	5	X	X
Mali	4.8	343	659	281	164	X	X
Mauritania	1.1	-	-	-	-	XX	X
Niger	3.5	30	463	1 147	1 181	X	X
Nigeria	59.8	1 430	4 566	4 924	4 753	X	X
Portuguese Guinea	0.5	-	-	-	-	XX	XX
Senegal	3.7	2	-	-	-	X	X
Sierra Leone	2.4	90	60	293	1 638	X	X
Togo	1.7	34	13	199	265	X	X
Upper Volta	5.1	8	14	76	90	X	X
Total	114.4	3 583	6 236	7 559	9 614		

* 1967 (estimated).

X Systematic programmes in operation or to be initiated or intensified with bilateral assistance and/or assistance from WHO.

XX Continuation of existing programme of vaccination.

FIG. 3 SMALLPOX CASES BY FOUR-WEEK PERIOD - AFRICAN REGION (WEST AND CENTRAL)

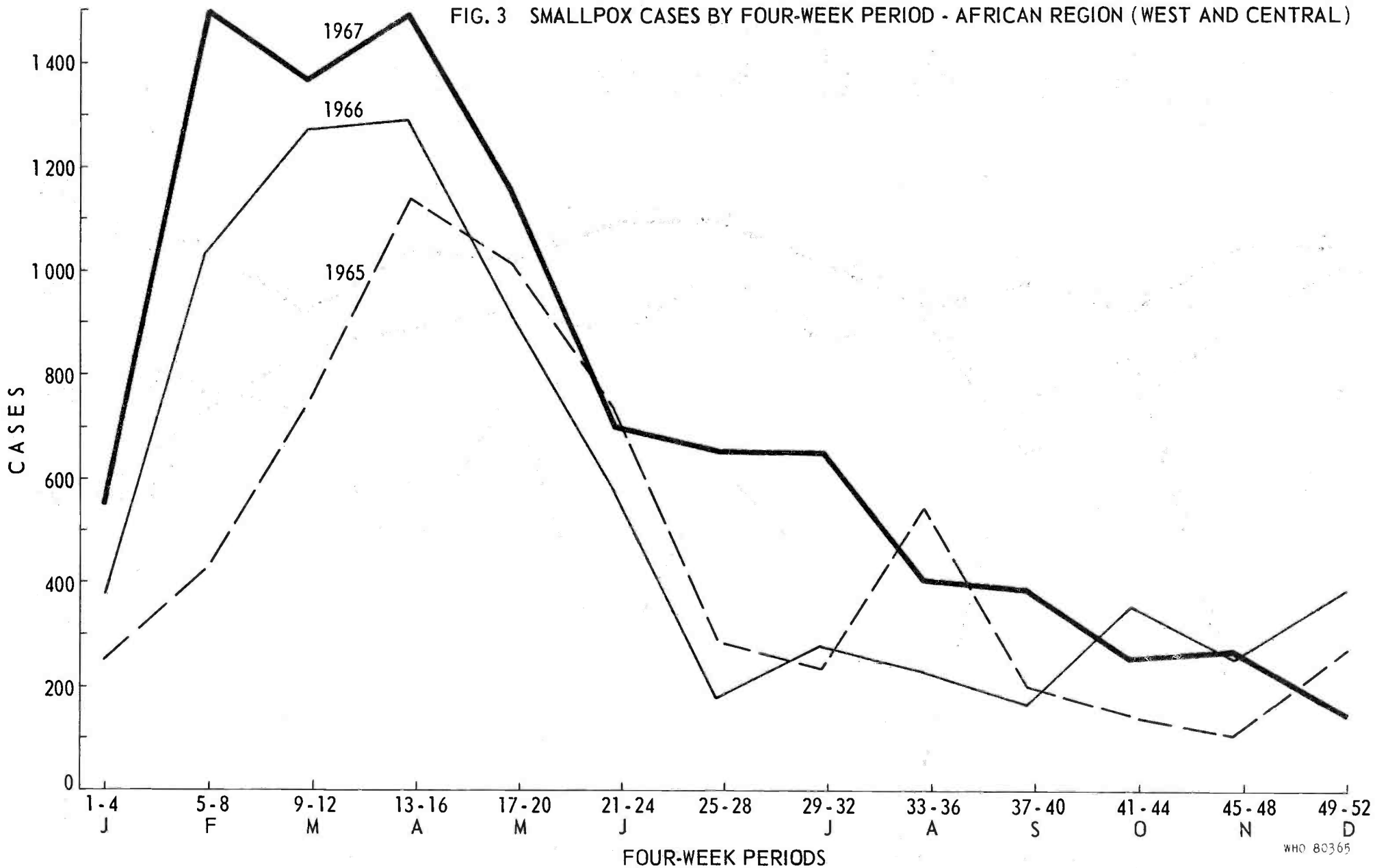


FIG. 4 SMALLPOX CASES BY FOUR-WEEK PERIOD - AFRICAN REGION (EAST AND SOUTH)

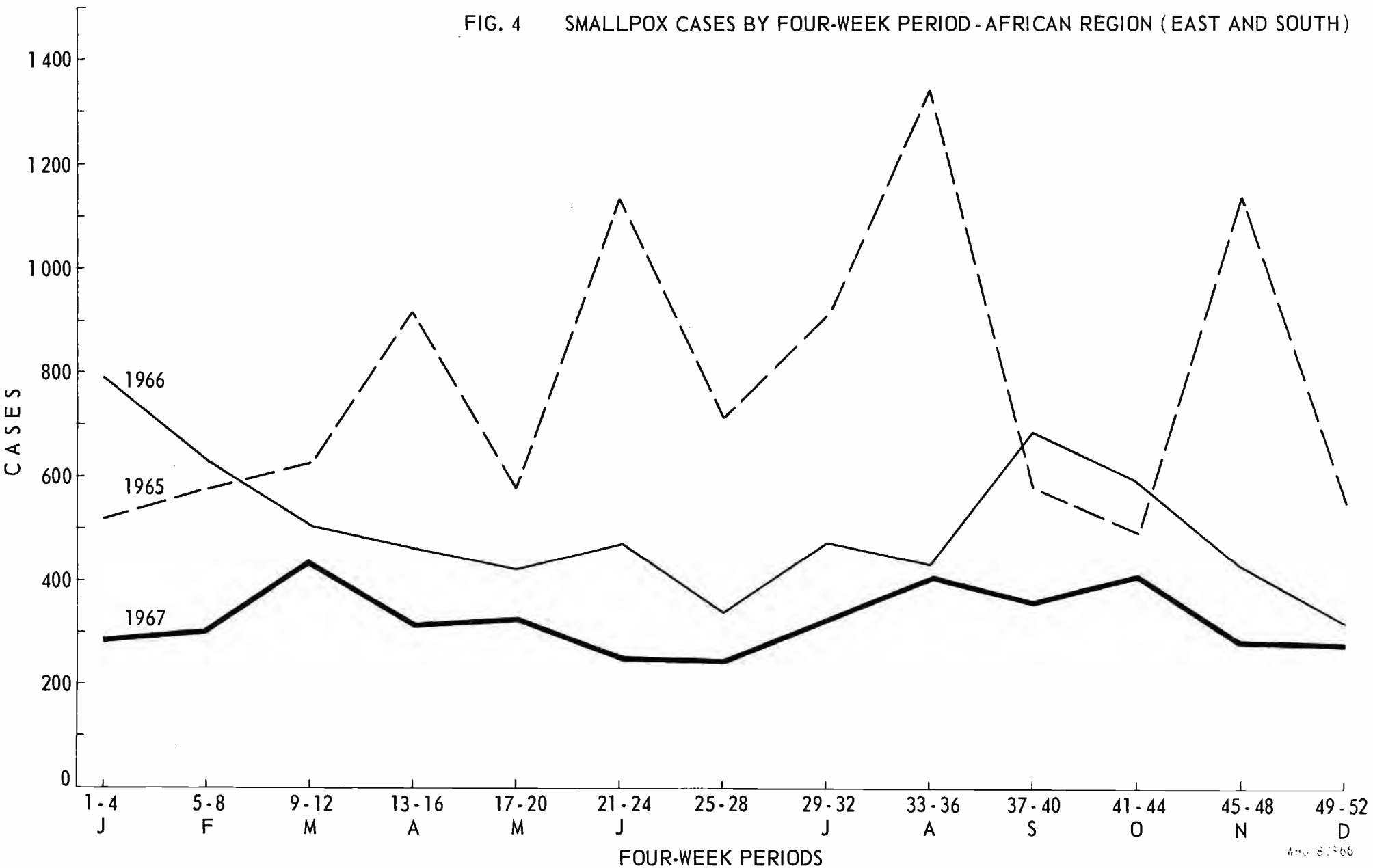


TABLE 5. AFRICA (EAST AND SOUTH)
SMALLPOX INCIDENCE AND PROGRAMME ACTIVITIES IN SMALLPOX ENDEMIC
AND NEIGHBOURING COUNTRIES AND TERRITORIES

Country or Territory	Population* (millions)	Smallpox cases reported				Eradication ^(A) activities	
		1964	1965	1966	1967	1967	1968
Angola	5.5	1	-	3	-	XX	XX
Botswana	0.6	175	-	-	1	XX	XX
Burundi	3.3	-	1 213	363	74	XX	X
Congo (Democratic Republic of)	16.3	2 191	3 783	1 913	1 451	X	X
Ethiopia	23.4	104	58	228	466	XX	X
Fr. Ter., Afars & Issas	0.08	-	-	52	-	XX	XX
Kenya	9.9	273	276	159	123	XX	X
Lesotho	0.9	-	-	-	-	XX	XX
Malawi	4.1	720	228	88	39	XX	XX
Mozambique	7.1	243	115	19	104	XX	XX
Rwanda	3.3	-	5	-	-	XX	X
Somalia	2.7	-	-	-	-	XX	X
South Africa	18.7	301	191	256	35	XX	XX
Southern Rhodesia	4.5	200	40	33	26	XX	XX
Sudan	14.3	-	64	-	7	X	X
Swaziland	0.4	517	85	29	10	XX	XX
Uganda	7.9	510	1 362	591	366	XX	X
United Republic of Tanzania	10.9	1 461	2 743	3 027	1 508	XX	X
Zambia	4.0	2 214	528	63	47	X	X
Total	138.6	8 910	10 691	6 824	4 257		

* 1967 (estimated)

(A) X Systematic programmes in operation or to be initiated or intensified with bilateral assistance and/or assistance from WHO.

XX Continuation of existing programme of vaccination.

1.2 Programme development

During 1967, 21 countries in Africa commenced smallpox eradication programmes. Bilateral assistance from the United States of America provided the principal material and technical assistance to 19 West and Central African countries. Programmes in seven of the 19 countries in this area are also being assisted by WHO. With the extensive use of jet injectors in this programme over 20 million of the 104 million persons in 14 of these countries were vaccinated during 1967.

TABLE 6

Country	Population (in 000's)	Smallpox vaccinations 1967 (000's)	Percentage relative to population
Cameroon	5 468	1 609	29
Central African Republic	1 415	381	27
Chad	3 411	1 381	40
Dahomey	2 475	702	28
Gabon	475	151	32
Gambia	342	231	68
Ghana*	8 160	1 318	16
Ivory Coast	4 038	1 467	36
Mali	4 156	891	19
Niger	3 543	1 387	39
Nigeria*	59 772	8 333	14
Senegal	3 666	397	11
Togo	1 725	625	36
Upper Volta	5 074	1 505	30
Total	104 320	20 378	20

* Pilot projects only from January to July

Systematic programmes in the Republic of the Congo, Guinea, Liberia, Mauritania and Sierra Leone are just beginning. Surveillance activities have been materially strengthened and in the majority of countries, all cases are now being investigated and containment measures instituted. Special vaccination programmes involving inter-country co-ordination have begun among nomad groups which move freely from country to country in certain parts of this region carrying smallpox from one area to another.

Programmes supported by WHO were initiated during 1967 in Zambia, Sudan and the Democratic Republic of the Congo. In the Sudan, during one 20-day working period, over 700 000 persons were vaccinated in Khartoum Province; several million vaccinations had been performed by the end of the year. During 1968, additional programmes have begun or are expected to begin shortly in six additional countries - Rwanda, Burundi, Kenya, the United Republic of Tanzania, Uganda, and Somalia. It is anticipated that the programme can be extended to the remaining countries in Africa during 1969.

WHO inter-country advisers are working in both West and East Africa to assist the programmes and to facilitate their effective co-ordination. An inter-regional seminar is planned during 1968 for principal smallpox eradication staff in the East African countries; a similar type of meeting is under consideration for the West African countries.

Several countries were assisted in the development and improvement of vaccine production facilities. Kenya, which received freeze-drying equipment from UNICEF in 1967 and consultant advice from WHO, is now able to produce good quality vaccine in quantities exceeding its own needs. Advice on vaccine production was also provided by WHO consultants to Ethiopia, and through bilateral aid to Nigeria; a virologist from the Pasteur Institute, Senegal, was given a fellowship for specialist training in vaccine production; the laboratory at Kindia, Guinea, received freeze-drying equipment from UNICEF and will begin vaccine production late in 1968 with technical assistance from WHO. These laboratories, together with laboratories in the Democratic Republic of the Congo and Rwanda, will eventually have a production capacity adequate to supply the needs of all the African countries.

2. South America

2.1 Smallpox incidence

Brazil represents the primary, and perhaps only, continuing endemic focus of smallpox in the Americas (Table 7, Fig. 5). Although a few cases were reported in 1967 from Argentina and Colombia, the cases in Argentina are known to have resulted from several separate introductions from Brazil and those in Colombia may have been of a similar origin. While the reported number of smallpox cases has been declining during the past four years in other countries of the Americas, the number of cases in Brazil has been progressively increasing.

TABLE 7. THE AMERICAS
SMALLPOX INCIDENCE AND PROGRAMME ACTIVITIES IN SMALLPOX ENDEMIC
AND NEIGHBOURING COUNTRIES AND TERRITORIES

Country or Territory	Population* (millions)	Smallpox cases reported				Eradication ^(A) activities	
		1964	1965	1966	1967	1967	1968
Argentina	23.0	13	15	21	23	X	X
Bolivia	3.8	5	-	-	-	X	X
Brazil	87.2	3 076	3 269	3 518	4 335	X	X
Chile	9.0	-	-	-	-	X	X
Colombia	19.2	21	149	8	5	X	X
Ecuador	5.5	42	-	-	-	X	X
French Guiana	0.04	-	-	-	-	XX	XX
Guyana	0.7	-	-	-	-	XX	XX
Paraguay	2.2	7	32	5	-	X	X
Peru	12.4	454	18	13	-	X	X
Surinam	0.4	-	-	-	-	XX	XX
Uruguay	2.8	3	1	-	-	X	X
Venezuela	9.4	-	-	-	-	X	X
Total	175.64	3 621	3 484	3 565	4 363		

* 1967 (estimated).

(A) X Systematic programmes in operation or to be initiated or intensified with bilateral assistance and/or assistance from WHO.

XX Continuation of existing programme of vaccination.

Of the 4335 cases recorded in Brazil during 1967 (i.e. 99.4 per cent. of all cases in the Americas) over half were reported from the State of São Paulo. This State, comprising only 19 per cent. of the population in Brazil, recorded 2261 cases or 52 per cent. of the total. The remaining cases are concentrated principally in the southern and central part of the country (Fig. 6).

2.2 Programme development

An eradication programme commenced in Brazil early in 1967 with WHO material and technical assistance. Vaccination is being carried out, in large part, by jet injection. Although over six million were vaccinated, during 1967, progress in the campaign did not meet expectations. Difficulties were experienced in using the considerable daily capacity of the jet injectors to the full. The programme has been replanned and is now progressing somewhat more satisfactorily. Surveillance, field investigation and containment of outbreaks have been emphasized from the inception of the programme; a surveillance bulletin is now published on a weekly basis. Reporting of smallpox is more complete than before, accounting in part for the apparent increase in cases this year in Brazil, especially in the State of São Paulo.

Virtually all other countries in South America have initiated special programmes to improve population immunity and surveillance for suspect smallpox cases.

With the advice of consultants and fellowship training provided by the University of Toronto (Canada), the quality and quantity of vaccine is being steadily improved in the 11 laboratories producing freeze-dried vaccine in South America.

3. Asia

3.1 Smallpox incidence

During 1967, the five smallpox endemic Asian countries reported a total of 96 908 cases, almost double the number of cases recorded during 1966 and over 80 per cent. of the world total (Table 8, Fig. 7). Three-fourths of these cases were reported from India which experienced widespread epidemics in several northern and north-western provinces. An increased incidence of smallpox was also observed in East and West Pakistan; serious outbreaks occurred in several parts of Indonesia; in Afghanistan, reported cases of smallpox increased during the latter half of the year; in Nepal, case reporting is still too incomplete to permit appraisal of the extent of disease. Burma, at the end of three years of a well-supervised and executed programme, reported no cases during 1967, its first smallpox-free year in recorded history. In Laos and Cambodia assessment surveys for scars of smallpox confirm that the disease has not been present in these countries for probably a decade or more. From these and other reports, it is most probable that, except in Indonesia, endemic smallpox is no longer present east of the Pakistan-India-Burma border.

FIG. 5 SMALLPOX CASES BY FOUR-WEEK PERIOD - SOUTH AMERICA

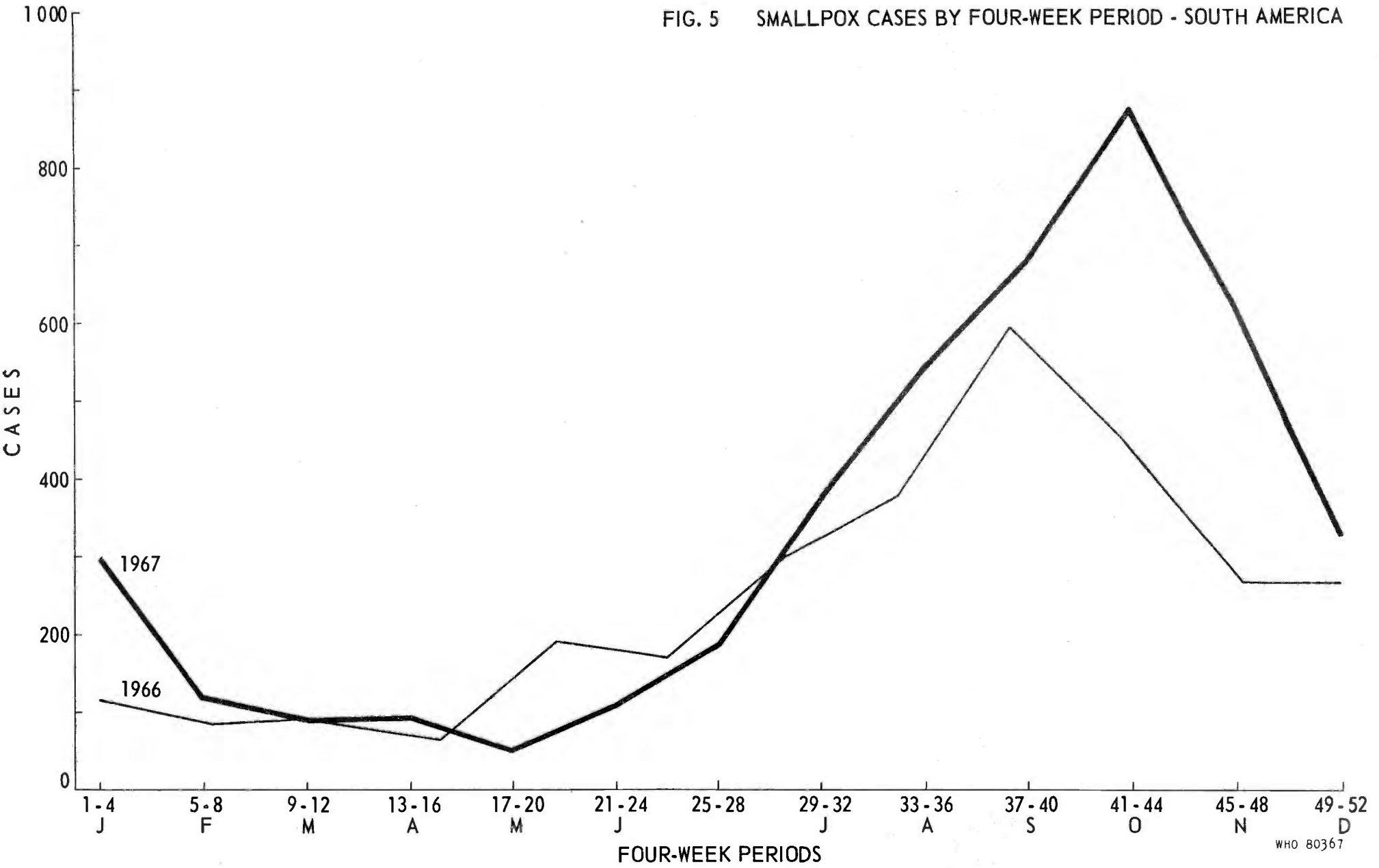


FIG. 6
BRAZIL
SMALLPOX INCIDENCE PER 100 000, 1967

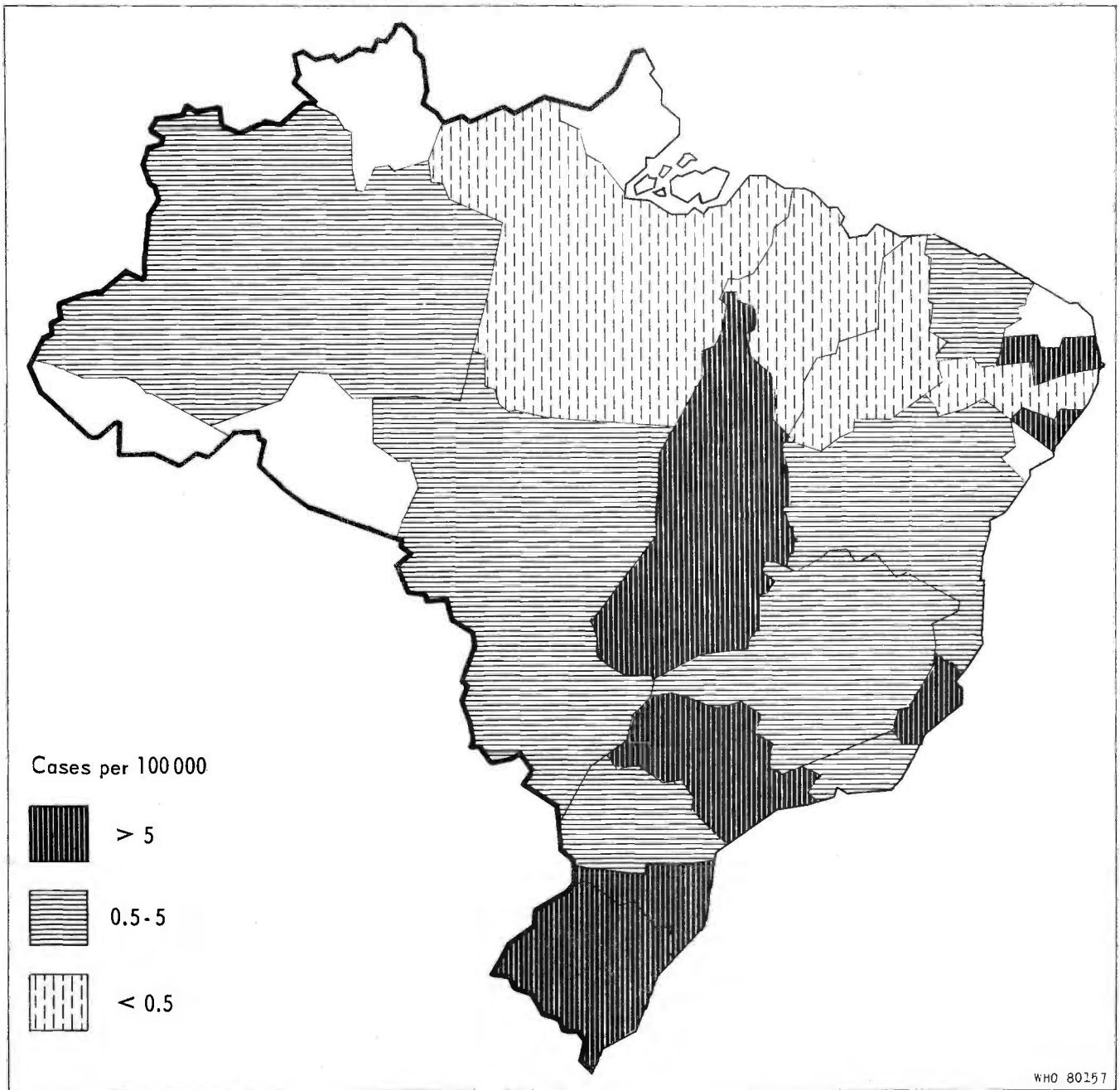
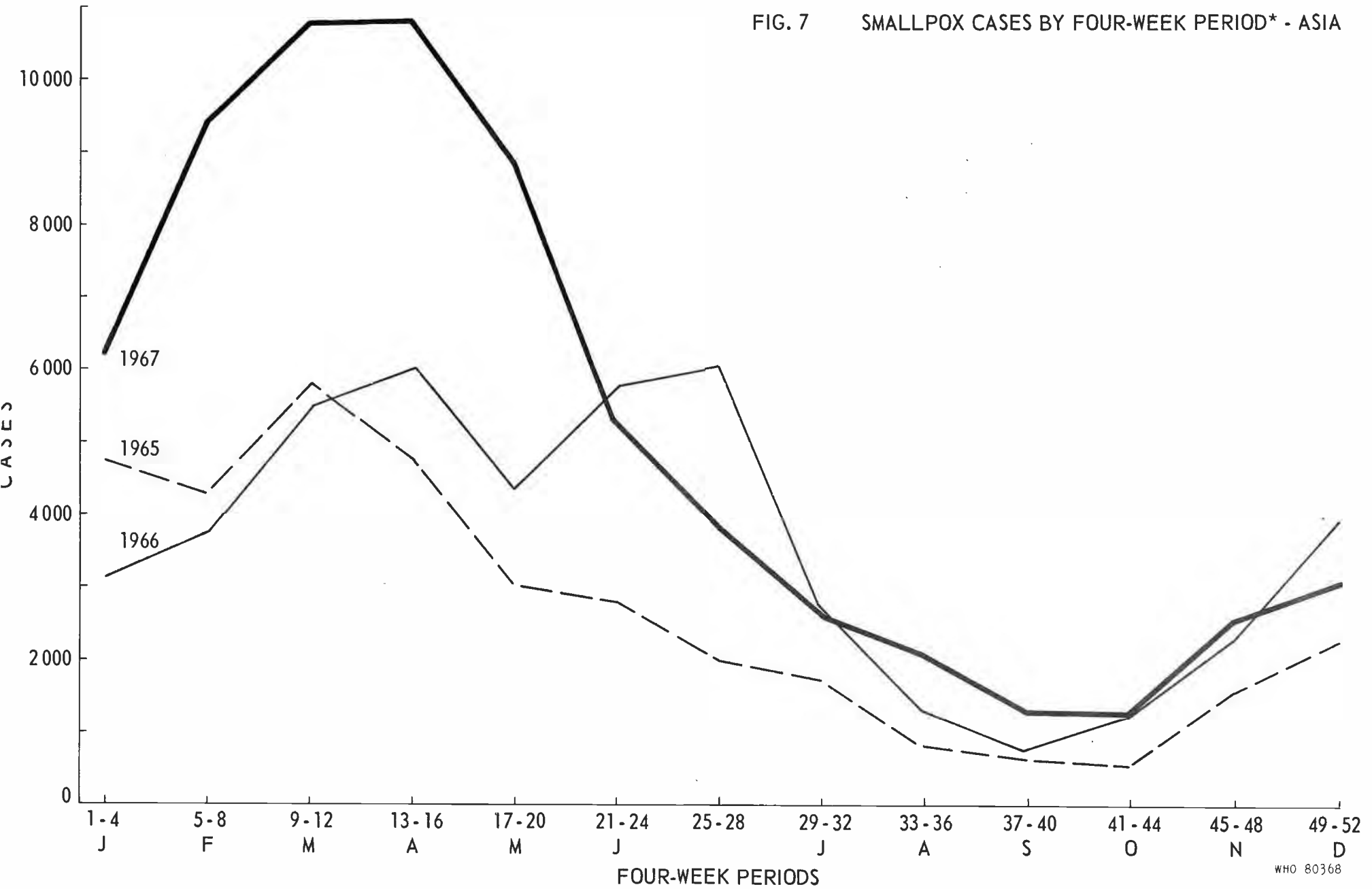


FIG. 7 SMALLPOX CASES BY FOUR-WEEK PERIOD* - ASIA



*28394 additional cases cannot be accounted for by month and are not shown on graph

FIG. 8
INDIA AND EAST PAKISTAN
SMALLPOX INCIDENCE

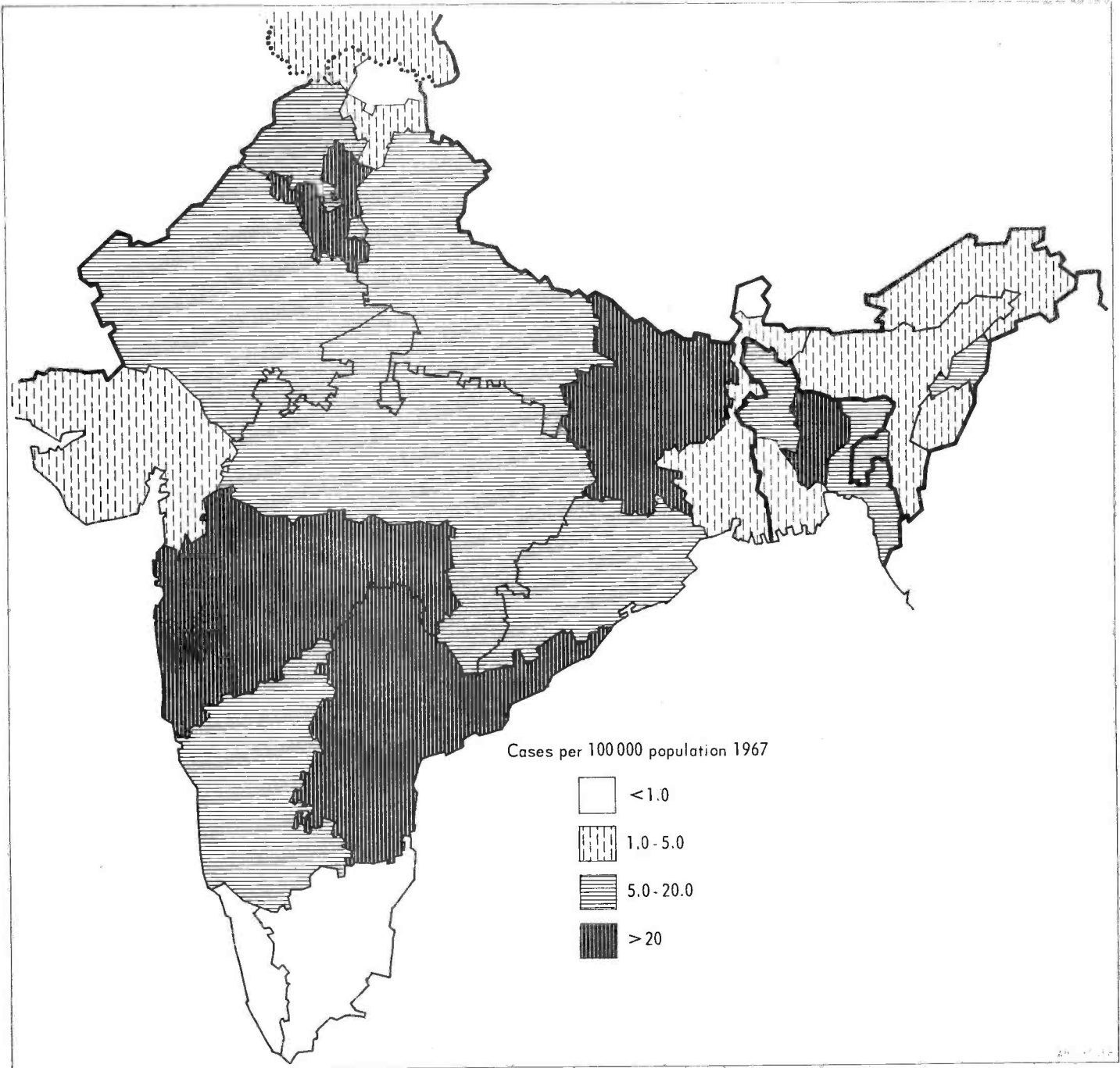


TABLE 8. ASIA
SMALLPOX INCIDENCE AND PROGRAMME ACTIVITIES IN SMALLPOX ENDEMIC
AND NEIGHBOURING COUNTRIES AND TERRITORIES

Country or Territory	Population* (millions)	Smallpox cases reported				Eradication activities	
		1964	1965	1966	1967	1967	1968
Afghanistan	16.2	178	74	64	202	X	X
Burma	25.8	112	53	6	-	X	X
Cambodia	6.5	-	-	-	-	XX	X
Ceylon	11.8	-	1	-	1	XX	XX
India	510.6	40 265	33 402	32 616	80 174	XX	X
Indonesia	109.5	1 870	3 990	11 296	5 767	XX	X
Iran	26.2	1	-	-	-	XX	XX
Iraq	8.6	-	-	1	-	XX	XX
Kuwait	0.5	-	-	-	41	XX	XX
Laos	2.8	-	-	-	-	XX	X
Malaysia	10.0	-	-	5	-	XX	XX
Nepal	10.5	135	70	164	144	X	X
Pakistan - East	57.3	45	316	3 207	5 921	XX	X
West	48.3	935	1 285	2 935	4 700	XX	X
Philippines	34.6	-	-	-	-	XX	XX
Saudi Arabia	6.9	-	-	-	-	XX	X
Thailand	32.5	-	-	-	-	XX	XX
Trucial Oman	0.1	-	-	-	10	XX	XX
Yemen	5.1	5	-	1	3	XX	X
Total	923.8	43 546	39 191	50 295	96 963		

* 1967 (estimated)

(A)X Systematic programmes in operation or to be initiated or intensified with bilateral assistance and/or assistance from WHO.

XX Continuation of existing programme of vaccination.

High rates of smallpox were recorded throughout most of Central and Northern India and East Pakistan. Only Kerala and Madras States in India recorded rates of less than one case per 100 000. The highest rates were observed in Maharashtra, Haryana and Bihar (57.4, 51.1 and 22.1 respectively) (Fig. 8).

3.2 Programme development

In Afghanistan and Nepal, eradication programmes, assisted by WHO advisers, have now been in progress for several years. These programmes were reviewed in detail during 1967 and new plans of operations developed for accelerated and more effective programmes. Additional material assistance is being given by WHO to support these efforts. In Afghanistan, assessment surveys carried out in many parts of the country reveal that substantial progress towards smallpox eradication has been made. Although inadequate reporting is still a problem, case surveillance is being strengthened; simplified records systems have been introduced; case investigation and containment activities have been instituted; a contingent of female volunteers from the United States of America working with Afghani staff and a WHO nurse adviser have commenced a special programme for vaccinating women and young children; vaccine storage facilities have been improved. With support by the Government of Afghanistan and assistance from the USSR in the form of freeze-dried vaccine, it is expected that the remaining reservoir of endemic smallpox in Afghanistan could be eliminated. Although the programme in Nepal is gradually being strengthened, eradication cannot be anticipated in the near future because of difficult transport and communications problems, migration between highly-endemic Indian areas and Nepal, and a limited surveillance and reporting system.

In Indonesia, pilot programmes assisted by WHO are beginning in Java and Bali. Additional equipment for vaccine production is being provided by UNICEF and necessary technical assistance by WHO. Although substantial quantities of vaccine from external sources will be required for the programme during 1968 and 1969, Indonesia should be self-sufficient with respect to smallpox vaccine production in 1970.

Eradication programmes have been developed in both East and West Pakistan with WHO assistance. The vaccine production facility in Dacca is now producing substantial quantities of good quality freeze-dried vaccine and is being provided by WHO with additional material support and consultants to enable it to meet the expanded needs of the Pakistan programme.

In late 1967, a team composed of Indian and WHO staff assisted by consultants conducted an intensive 10-week assessment of the Indian eradication programme at national, state, district and block levels. During the three-year mass vaccination programme, which concluded this year, 537 million vaccinations had been performed in India, employing freeze-dried vaccine supplied principally by the USSR. The number of recorded vaccinations exceeded, in fact, the total number in the population. However, from the recorded incidence of smallpox this year, the second highest in a decade, the assessment team noted that in spite of very substantial efforts made by the national health administrators, there were still gaps and problems in the supervision, planning and implementation. The programme operates under extremely difficult ecological conditions, which include large agglomerations and movements of the population. Added to this were problems of storage and transport of vaccine. All these factors led to incomplete coverage of the susceptible population. The findings of the assessment team are currently being studied with a view to developing a plan of operation which will overcome these difficulties.

Other countries in South-East Asia are increasing vaccination programmes and surveillance activities to prevent reintroduction of smallpox. A systematic large-scale vaccination programme is being continued in Burma, with assistance in the form of freeze-dried vaccine, provided by the USSR; supplies, including vaccine, are being provided by WHO to Laos and Cambodia to enable them to improve the immunity level in their populations; the Philippines has initiated an extensive programme of vaccination in its southern provinces to protect against possible reintroductions from Indonesia; freeze-drying equipment and technical assistance is being given to Ceylon.

III. GENERAL PROGRAMME DEVELOPMENT

1. Central programme activity

In 1967, the initial year of the intensified programme of smallpox eradication, major efforts were directed towards the development of materials setting forth the technical and operational strategy of the programme; to advising on their application; and to securing an adequate supply of freeze-dried vaccine both through provision of assistance to producing laboratories and through donations. In 1968, in addition to continuing and extending these activities, greater attention will be devoted to the development of laboratory diagnostic methods for smallpox, to the establishment of reference laboratories and to research activities in smallpox.

A 250 page "Handbook for Smallpox Eradication" was printed in July; by November, 900 copies had been distributed and an additional printing was required to satisfy the many requests still being made. A French edition will be ready at the end of May 1968.

During October, a Scientific Group on Smallpox Eradication was convened in Geneva to consider the present status of knowledge regarding smallpox and smallpox eradication and to consider particularly the methodology and strategy for eradication.

A Travelling Seminar on Vaccine Production was conducted during March 1968 to review published and unpublished material dealing with vaccine production and to develop a detailed illustrated manual dealing with the production of freeze-dried smallpox vaccine grown on animal skin.

An illustrated manual of recommended procedures for smallpox virus diagnosis is being completed and will be employed in courses on this subject to be conducted during 1969 at designated regional reference diagnostic centres. Arrangements were made to obtain sufficient quantities of high titre freeze-dried antigen and antisera to supply the routine needs of diagnostic laboratories.

2. Surveillance of smallpox

The development of effective programmes of smallpox surveillance in every country is as important as the vaccination programme itself. Comparatively little emphasis has been placed on this during recent years, but it is already clear that an effective surveillance programme can serve materially to shorten the duration of the eradication programme.

The Scientific Group on Smallpox Eradication described surveillance as:

"The prompt detection and reporting of all suspect smallpox cases, the immediate investigation and confirmation of such cases, and the institution of appropriate containment measures. Concurrent analysis and interpretation of reported data and the dissemination of this information to responsible local, national and international authorities is essential."

The urgent need for implementation of this activity is being stressed in all programmes. Progress is being made in some, and efforts are now being made to determine how best to implement surveillance on a global basis in accord with the recommendations of the Scientific Group: "Effective coordination requires that all countries regularly report the occurrence of smallpox and progress in their eradication programmes. The Organization should collect this information and make it widely available to all concerned with the eradication effort."

3. Vaccine supplies

A continuing problem is the need for adequate quantities of freeze-dried smallpox vaccine in the endemic countries. As previously noted, emphasis has and is being placed on the development of production facilities in endemic areas, which can efficiently produce vaccine on a year round basis. Studies to date indicate that a laboratory capable of producing 10 million doses annually represents the minimum effective size. It is to be noted that vaccine production equipment has now been provided to all countries demanding this or greater quantities of vaccine. Improvement and expansion of existing vaccine production laboratories is thus being emphasized. In the Americas, the University of Toronto (Canada), under an agreement with WHO, continues to provide consultation and assistance to 11 laboratories in South America. Consultants from various established production centres are assisting in other parts of the world. Special consideration is now being given to the problems of maintenance and repair services, and the provision of necessary spare parts to insure maximum productivity of existing facilities.

Special studies are in progress to evaluate the comparative efficacy and reactogenicity of vaccine strains currently available for use. Studies of the characteristics and comparative yields of these strains in routine production are also in progress.

All countries are being urged to submit vaccine specimens regularly for testing purposes. The increased utilization of this service is reflected by the fact that only 12 lots were tested in 1965; 43 in 1966; and over 100 in 1967.

Requirements for freeze-dried vaccine are now substantial and are expected to increase significantly during 1968 and 1969. Thanks to a donation of 75 million doses of vaccine from the USSR for the three-year period 1967-1969 and smaller donations from a number of other countries, the needs in 1967 have been met, but the supply of vaccine now available to the Organization in the Special Account for Smallpox Eradication is not sufficient to fulfil the estimated requirements, and a deficit may be expected during 1969 (Table 9).

TABLE 9. DISTRIBUTION OF VACCINE BY WHO
(IN THOUSANDS OF DOSES)

1965	1966	1967	1968*	1969*
2 290	3 767	13 008	56 000	60 000

* Projected needs.

It should be observed that in addition to the amounts noted above, more than 150 million doses of vaccine are now being provided annually to endemic countries on a bilateral basis by the USSR and by the United States of America.

4. Development of vaccination devices

Field evaluation of a foot-operated jet injector, currently in use in West Africa and Brazil, indicates that this device is sufficiently sturdy and effective for its use to be extended, particularly for vaccination campaigns in densely populated areas and in outbreak containment activities. Additional injectors have been procured and will be made available during 1968 to countries requesting them, following the training of national and local personnel in their use and repair.

A number of studies have been carried out during 1967 employing a lighter, less expensive hand-operated injector. Although of considerable practical value if effective, studies to date have revealed an unsatisfactory level of vaccine takes following administration of vaccine with this injector. Additional studies of other types of injectors are being planned.

Field tests have also been conducted employing for vaccination a needle whose functional end is in the form of a double pronged fork. The vaccine is retained between the prongs of this bifurcated needle, applied to the skins surface, and the vaccination is effected by the multiple puncture technique utilizing the two sharp points of the needle end. A major advantage is the fact that with this needle only .002 ml of vaccine is used in performing a vaccination contrasted to .01 ml or more with conventional techniques. Studies have shown that a high proportion of primary and revaccination takes can be obtained with this new needle. The rates are in fact equivalent to, or better than, those obtained with conventional devices. This needle can be sterilized by boiling or flaming and reused many times. A simplified production technique has been worked out with the manufacturer which permits the needles to be purchased for little more than the cost of a disposable vaccinostyle. It is expected that by the end of this year the bifurcated needle will have replaced the conventional vaccinostyles in many programmes.

5. Emergency vaccine reserve and technical assistance

Early in 1967, a small emergency vaccine reserve was established in WHO headquarters to permit the rapid despatch of vaccine in case of emergencies. Three requests of this type were received within a two-month period after the establishment of the reserve supply. In March, for example, the Trucial States experienced several simultaneous introductions of smallpox from India. Because of the largely unvaccinated status of the population, an urgent request for assistance was sent to WHO. Less than 36 hours after the despatch of their cabled request, a WHO medical officer with 100 000 doses of vaccine arrived in the principal city, Dubai.

In addition to this vaccine reserve, several jet injectors have now been purchased and stockpiled in WHO headquarters; others will be made available in 1968 to some regional offices; a panel of consultants immediately available for emergency assistance is being constituted.

6. Training courses and seminars

Special courses in the laboratory diagnosis of smallpox were conducted in 1967 in South America. Similar courses for countries in other areas of the world are being planned for 1969.

An Inter-Regional Seminar for Asian countries on Smallpox Eradication took place in Bangkok in December 1967. A seminar on smallpox eradication is planned for November 1968 for East African countries. Training in the methodology of operations, surveillance, assessment, jet injector use and maintenance will be provided at national level by WHO regional and headquarters staff and consultants.

7. Fellowships

The principal need in fellowship training is for vaccine production. Comparatively few production laboratories presently have the space or facilities to provide this or, if available, language frequently poses a barrier. This problem is under study in the hope that one or two production laboratories in endemic countries might be adequately strengthened to permit offering this type of training.

8. Research

As previously noted, several studies are in progress relating to cheaper, more effective devices for vaccine administration, either by jet injection, or by multiple puncture application. Further studies of the epidemiology and patterns of spread of smallpox will be initiated in 1968 and extended in 1969. These studies, designed to determine the precise patterns of spread of smallpox will facilitate programme operations by identifying those groups requiring special attention in the immunization programme. Other studies in progress or to be initiated include those dealing with comparative characteristics of vaccine strains to determine those most suitable for use; appraisals of the safety, efficacy and stability of smallpox vaccines propagated in tissue cultures; assessment of the relative efficacy of vaccination over different time periods and under circumstances of natural challenge; operational studies, including studies of jet injectors, to determine the most efficient and economical means of conducting vaccination programmes. Promising chemoprophylactic and chemotherapeutic agents will be tested and evaluated.

9. Collaboration with other agencies

The League of Red Cross Societies continues to give support to the programme contributing, through national societies, in assisting with health education and publicity and vaccination clinics.

The possible use of food subsidies as additional support for field personnel will be evaluated in several countries during 1968 in co-operation with the World Food Program.

IV. ERADICATION METHODOLOGY

1. General considerations

Technical policies and eradication methodology are being subjected to critical evaluation in order to develop the programme on a sound basis. These were reviewed by the Scientific Group on Smallpox Eradication which met in October 1967.¹

"The objective of the smallpox eradication programme is achieved by reducing the prevalence of smallpox to the point where transmission of the disease is terminated. Normally, as a first step, this requires systematic mass vaccination with potent freeze-dried vaccine to reduce the prevalence of disease. Simultaneously, however, a case detection and recording system should be established or improved to permit prompt application of containment measures, thereby interrupting further transmission.

¹ Report now being prepared for publication in the WHO Technical Report Series.

"Eradication programmes must focus attention on both of these major components, giving perhaps greater weight to the former activity in highly endemic, poorly vaccinated areas and shifting emphasis as endemic disease declines and a more satisfactory state of herd immunity is achieved.

The detection of every case of smallpox which occurs is nearly impossible when the disease incidence in a country is high. As the incidence is reduced, however, the need to detect and trace the sources of infection in cases becomes of paramount importance. This requires an alert and comprehensive reporting network as well as the epidemiological capacity to investigate all suspect cases and the clinical laboratory capacity to confirm or refute the diagnosis. The reporting of 'no cases' must be as dependable a routine as that for reporting the occurrence of cases.

Theoretically, the interruption of smallpox transmission could be accomplished by the simultaneous immunization of the whole community. Since this is not feasible, mass vaccination is unlikely to result in eradication if it is the only method employed. Mass vaccination serves to reduce the volume of variola virus transmission but other techniques must be employed to eliminate the residuum. When the number of cases occurring in an area is reduced to a relatively few in a year, case detection and containment by vaccination of contacts, isolation of patients and disinfection will be effective in eliminating residual foci of infection.

After a large proportion of the population has been covered by mass vaccination, and while the surveillance and outbreak-containment teams are seeking out and eliminating the remaining pockets of infection, an effective immune barrier must be maintained. This is accomplished by systematic primary vaccination of newborns and revaccination of those previously protected.

The programme of smallpox eradication can be considered to progress through a series of phases commencing with the institution of the systematic mass vaccination programme and continuing until continental eradication has been achieved. Three general phases can be broadly defined; Attack Phase (Phase I), Consolidation Phase (Phase II), and Maintenance Phase (Phase III). These terms can be applied to regions of a country or to the country as a whole; in most programmes, progression from phase to phase may be expected to occur in some regions earlier than in others. Only when all regions have progressed to a higher phase can the country as a whole be considered to have entered that phase.

Attack Phase (Phase I)

Endemic areas with an incidence of smallpox of five or more cases per 100 000 population per year and with less than 80 per cent. of all segments of the population showing scars of primary vaccination.

Consolidation Phase (Phase II)

Areas with an incidence of smallpox of less than five cases per 100 000 and in which over 80 per cent. of all segments of the population show scars of primary vaccination.

Maintenance Phase (Phase III)

Areas free of endemic smallpox for more than two years but geographically situated in endemic continental areas, presently Africa, Asia and South America.

The nature and intensity of the component activities of the eradication programme will vary from phase to phase. They are summarized in Table 10.

TABLE 10. PHASES IN THE ERADICATION PROGRAMME

	Attack phase (Phase 1)	Consolidation phase (Phase 2)	Maintenance phase (Phase 3)
Vaccination	Systematic mass vaccination	Continuing maintenance vaccination	Continuing maintenance vaccination
Surveillance	<p><u>Reporting</u></p> <p>Establish prompt and regular reporting of smallpox by all existing health facilities.</p> <p><u>Field investigation</u></p> <p>Epidemiological investigation of major outbreaks throughout the country and of all cases in areas where systematic mass vaccination has been done.</p>	<p><u>Reporting</u></p> <p>Extension of case detection system to assure that all suspected smallpox cases are reported.</p> <p><u>Field investigation</u></p> <p>Prompt epidemiological investigation of all cases to establish sources of infection and to exclude the possibility of unreported cases.</p>	<p><u>Reporting</u></p> <p>Continuation of case detection system to assure that all suspected cases are reported.</p> <p><u>Field investigation</u></p> <p>Each case investigated as an emergency by an epidemiologist.</p>
Laboratory	Establish techniques and methods for the submission and examination of specimens for confirmation of diagnosis.	Specimens studied from all isolated cases and representative samples from each outbreak.	Specimens studied from every suspect case.
Containment	Localized, intensive vaccination in communities where cases or outbreaks occur. Isolation of cases if feasible and disinfection.	Vaccination and observation of case contacts. Isolation of cases and appropriate disinfection. Localized, intensive vaccination in community.	Vaccination and observation of case contacts. Isolation of cases and appropriate disinfection. Localized, intensive vaccination in community.

2. Priorities in vaccination programmes

While vaccination programmes are intended to provide protection to all persons in the population, studies and observations made during the past year clearly indicate that certain groups are of much greater importance than others in maintaining the transmission of disease and thus deserve much greater attention to assure that they are vaccinated.

In all areas in which the vaccination status of smallpox cases has been examined, cases among individuals who have never been vaccinated are found to constitute from 70 to 95 per cent. of the total. This suggests that immunity following vaccination is far more durable than is sometimes thought. Further, carefully conducted studies of smallpox transmission in families in India reveals that transmission of disease occurs three times as frequently when the first (index) case has never previously been vaccinated. That the previously vaccinated individual is less capable of transmitting infection is confirmed by various virological studies. These observations emphasize the need in vaccination programmes to assure maximum coverage of the population by at least primary vaccination.

The importance of assuring complete vaccination among children is reflected by the fact that, in most areas, two-thirds or more of all cases occur among those less than 15 years of age. Additionally, as in most infectious diseases and presumably also in smallpox, children serve as much more efficient vectors of infection than do adults. This group therefore commands particular attention.

Two studies were recently conducted in Asian countries to determine patterns of smallpox transmission over wider geographic areas. In the areas studied moderate levels of immunity had been induced by vaccination. It was found that, in the rural areas, smallpox was introduced repeatedly from major towns but that infection persisted for only two to five generations and ceased. In the urban areas, smallpox was constantly present. These findings emphasize the particular need for thorough vaccination in the more densely crowded urban areas where contacts are maximal and transmission most likely.

Recent outbreaks in Brazil, Africa and Kuwait as well as past experiences in European outbreaks, document the hospital to be a most important site of smallpox transmission. In these outbreaks, smallpox cases, inadequately isolated or undiagnosed, mingled with patients admitted with other diseases at a time when their potential for transmission was high. Frequently, many secondary cases occurred; these individuals experienced a higher than usual case-fatality rate; patients who developed infection subsequent to discharge dispersed over a wide geographic area serving to infect many areas and communities.

From these observations, it is clear that all programmes should make special efforts to assure:

1. Maximum coverage of the population with at least primary vaccination - the vaccination scar serves as a most effective and permanent "vaccination certificate" permitting assessment of coverage at any time.
2. Maximum coverage of those less than 15 years of age. Children are usually most accessible for vaccination. Coverage can be facilitated by insisting upon compulsory vaccination of all schoolchildren, a practice common throughout the world and easily enforced. Vaccination of newborns, a procedure shown to be safe and effective, should be performed whenever possible.
3. Thorough vaccination of more densely crowded areas, particularly lower socio-economic sections, where migrants are common, the vaccination status is poor, and contacts frequent.
4. Vaccination of all admissions to infectious disease hospitals. This is now practised in some areas and has been found to be effective and without significant risk to patients suffering from other infectious diseases.