

DEVELOPMENT AND STATUS OF THE SMALLPOX ERADICATION AND  
MEASLES CONTROL PROGRAMME IN WEST AFRICA

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INTRODUCTION

In this introduction, I should like to review briefly the terms of reference and the goals under which this programme was developed, and the progress which we have made. I should like particularly to note those areas in which I feel more must be accomplished for it is these areas which should particularly occupy the focus of our attention during the course of the seminar.

BACKGROUND

In 1966, after consultation with the various Ministries of Health, a document was produced at the National Communicable Disease Centre entitled "Project for Smallpox Eradication and Measles Control in 19 countries of West Africa". Those of you familiar with the language of USAID will recognize this as the "Draft E-1", the initial plan for the regional programme.

The objectives were outlined as follows; "The primary goal of this regional project is the eradication of smallpox from 19 geographically contiguous countries in West Africa ... and the establishment of measles control programmes in each of these". The document laid out five secondary objectives to be realized in the pursuit of smallpox eradication and measles control:

- "1. The establishment, or in some countries improvement, of mobile disease control services capable of administering vaccines or other preventive medications efficiently, economically, and on a mass scale throughout the country.
2. The establishment in each country of a system of disease surveillance broadly applicable to a variety of communicable disease problems. Such a disease surveillance system includes the development of effective disease reporting mechanisms, epidemiological field investigations of specific problem areas and educative techniques designed to acquaint responsible medical personnel throughout the country with current problems of development related to the occurrence and control of the diseases of concern.
3. The development of highly simplified statistical sampling techniques applicable in these developing countries which will permit rapid assessment of disease problems.
4. The establishment of elementary virological laboratories in many of the countries capable of simple laboratory procedures for the diagnosis of smallpox.
5. Improvement of the existing smallpox vaccine production laboratory in Yaba, Nigeria, such that it is capable of producing stable, potent, safe vaccine of the multiple puncture type economically and in quantities sufficient for Nigeria and other countries in this area".

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The document provided guideposts for the measurement of progress in the programme as follows: "If the projected plan can proceed as scheduled, indigenously transmitted smallpox cases should cease by the end of the fourth year of the programme; by this time measles should be reduced to a level of sporadic occurrence or at most small focal outbreaks".

With regard to the last two objectives, it may be noted that the laboratory in Yaba now produces vaccine which meets WHO standards in all respects. There is a well functioning diagnostic laboratory in Nigeria, and intermittent diagnostic work is being done by other laboratories, principally in Ghana, but a comprehensive system of diagnostic services for all countries does not yet exist. The description of our progress in achieving the remaining objectives merits a more detailed review.

#### PRESENT STATUS OF OPERATIONS IN WEST AFRICA

Mass vaccination assessment and surveillance are the three major operational elements of the original comprehensive plan. We must, in retrospect, add one more, perhaps not so clearly seen in the original plan - maintenance activities.

#### MASS VACCINATION

There is no question but that each country has capably performed collecting point mass vaccination campaigns. Those countries, including most of the francophone countries, who had mobile immunization systems prior to the present regional programme, have continued to prosecute these vigorously. Other countries have developed such systems de novo to a high degree of effectiveness. Witness the fact that from January 1967 to the end of April 1969, 78.2 million smallpox vaccinations and 12.4 million measles vaccinations were performed. No country has failed to mount a successful mass campaign; despite political and social turmoil, as well as economic problems, mass campaigns have been sustained. Only where lack of transport has supervened have they been restricted. Among the 19 countries are 3 different systems of operation ranging from prospection team activities with several target diseases, to systems such as those in Upper Volta and Ivory Coast where the antigens of smallpox and measles are given by different organizations (Table 1). In most countries, the average output of vaccination teams has been good. In others, particularly those operating by prospection, the number of vaccinations per day is low enough to suggest that vaccination by Ped-0-Jet might economically be replaced by vaccination by bifurcated needle.

Overall, however, the programmes have been remarkably successful. This is particularly notable when one compares the progress to date with the objectives established at the beginning of the programme (Figure 1).

#### ASSESSMENT

Table 2 summarizes the Programme's status with respect to the statistical sampling assessment technique. Nine countries are presently conducting systematic assessments to determine vaccination coverage in the population. These assessments are generally carried out by formally constituted assessment teams established for the purpose. In another four countries, assessment activities have been carried out at intervals and under varying circumstances. There remain six countries in which continuing assessment of vaccination coverage has not been incorporated as a part of the national programme.

The most recent results obtained in assessments are shown in Table 3. Most countries conducting systematic assessments have determined that their vaccination programmes are reaching 80 percent or more of the population in most age groups. Groups with poor coverage have been identified and operational procedures modified in order to improve coverage. Notably, the over-45 year age group has been consistently identified as the one most difficult to reach.

Later in the conference, the so-called "terminal" or phase I assessments will be described. These have been conducted on a nationwide basis in Gambia, Gabon, Niger, Togo and Dahomey, and on a statewide basis in Northern and Western Nigeria. In brief, the terminal assessments have generally confirmed the adequacy of vaccination coverage in the various countries although acceptable levels were not reached in all. The assessments, however, have emphasized clearly that adequate population coverage is a momentary thing. There is a continuing dilution of population immunity as susceptibles, principally newborns, enter the population to constitute an ever-increasing reservoir for outbreaks. A constant awareness of this becomes critically important as one plans for maintenance activities to prevent the re-establishment of smallpox.

Assessment has also confirmed one of the attested advantages of administering smallpox vaccination by jet injection, i.e. the invariably high vaccination "take rates", even under sub-optimal conditions. As suggested by the original evaluations in the United States, Jamaica, and Brazil, the consistently high proportion of take rates obtained stands in contrast to the wide variability of "take rates" observed in programmes employing scratch vaccination or multiple pressure vaccination.

That there are still countries without formal assessment activities is to be deplored. Those countries deny themselves the security of assurance that their country's programmes are adequate. Of greater concern, these countries lack critical information on the extent and location of areas of poor coverage. As the entire region moves into maintenance vaccination activities, the vaccination of newborns and poorly vaccinated groups in particular geographic areas become increasingly important. To operate without formal assessment of coverage makes it virtually impossible to appraise the situation with accuracy.

#### SURVEILLANCE

While vaccination programmes in West Africa have been a clearcut success and assessment techniques, while less universally implemented, have proven their worth, progress in the surveillance component is more difficult to appraise. An adequate surveillance system consists of (1) a mechanism for reporting the disease (2) interpretation of the reported data, and (3) prompt response in the investigation and control of outbreaks which are identified.

Only nine countries are systematically reviewing the efficiency of their reporting systems by determining if the number of reports received from reporting sites is consistent with the number expected. In these countries, the efficiency of reporting, as measured in terms of reports received to reports expected, varies from as low as 30% to 100% (Table 4).

The "eradication escalation" exercise, which began in September 1968 and involved all 9 countries with endemic smallpox has encouraged more efficient identification of outbreaks and, particularly, more intensive outbreak control activities. However, even in these countries, one-half of the cases identified since October were detected by an active search for cases rather than through the routine reporting system.

With regard to the ability to react quickly and effectively when outbreaks are reported, one is struck by the variability between countries in the region. In some countries, the response of the local health authorities to reported smallpox is prompt and control vaccinations in limited areas surrounding the case are immediately undertaken. However, prior to September 1968, there were a number of smallpox endemic countries in which the response to reported cases was virtually nil. Even now, the response to reported outbreaks of measles is, in most countries, nil.

Surveillance must become an increasing pre-occupation with all of us. Programmes involving the active search for smallpox cases cannot last forever no matter how

successful they may be. Ultimately, reliance will have to be placed on the routine reporting system. Every effort must be made to see that a report, either positive or negative, is received from every reporting site at least once a month. The threat of re-introduction of smallpox is real. I need only mention Ethiopia where smallpox exists in abundance and which has probably been responsible for infecting Sudan both last year and this year. I must also cite the Democratic Republic of the Congo where an active smallpox eradication programme has not yet eliminated many areas of intense smallpox transmission. These countries are principal potential exporters of smallpox to West and Central Africa.

At the present time, only four countries have established surveillance newsletters or reports to provide analysis of the reported surveillance data for distribution to the people at the reporting source. Those reports which have been prepared have been done with considerable imagination and, in each instance, evidence exists to confirm that these have encouraged improved reporting. The investment of time in such a document is minimal. The fact that such reports do not exist in every country suggests in part a lack of success in emphasizing the importance of informing the field personnel of the use of the data reported.

Before leaving surveillance, I am obliged to comment on the quality of the epidemiological investigations. The ability to respond to reports of outbreaks with a complete and careful investigation is integral to the surveillance reflex arc. We have seen in West Africa the encouraging development of outbreak control or fire-fighting capabilities. We have not, however, seen a concomitant increase in the quality of epidemiological field investigations. Although everyone knows that smallpox cases do not occur as sporadic isolated phenomena, most of the field investigations reported are not sufficiently complete to permit an analysis of the infectiousness of smallpox, the period of infectivity, the source of disease, and the influence of living patterns on transmission. As from now, suspected cases of smallpox in West Africa will assume the same critical importance that they do in Europe and North America. The quality of epidemiological investigations and the intensity of control efforts will have to match those presently practiced in Europe or smallpox will surely be re-established.

#### MAINTENANCE

Some 11 countries have begun maintenance activities principally directed as measles control in urban areas. Maintenance activities will be an important topic in this meeting. Essentially all countries will complete the "attack phase" of mass vaccination this year, commodities permitting. Brilliant as the mass campaigns have been sustained freedom from smallpox, and the hope of measles control rests specifically on maintenance operations.

Maintenance consists of three principal elements: (a) effective and early immunization of incoming susceptibles, principally newborns, (b) the assessment of maintenance activities to assure that incoming susceptibles are reached in high proportion, (c) surveillance and epidemic control to permit the identification of suspected smallpox cases or measles outbreaks and the ability to respond with effective control measures.

Maintenance activities for both smallpox and measles are nationwide at present only in two countries, The Gambia and Gabon. In other areas, they are directed principally at cities. Ivory Coast is conducting nationwide smallpox maintenance activities. But before the present year is out, maintenance activities for both diseases must be planned in every country in the region.

It is highly likely that the requirements for measles control will demand in the maintenance phase a level of activity which exceeds original planning. Countries must confront these realities now, and decide whether the goals for measles control are realistic, and if so, plan to accommodate them.

## INNOVATIONS

There have been several extremely important developments in this programme which I think are unique. In view of the impact of the West African Programme on the conduct of smallpox eradication programmes around the world, these are in my judgement, worth review.

(1) This programme has demonstrated the importance of the non-medical and administrative health workers in a major disease control programme. The demonstration that non-medical operations officers could effectively organize smallpox eradication activities and conduct epidemiological investigations is an important contribution. It is consistent with the African aim to use wisely all available manpower resources. It is a contribution of considerable worth in the long-term development of health personnel resources throughout the world.

(2) The use of concurrent statistical sampling assessment of a mass campaign while not universally practiced, has been more widely employed in this programme than in any other African or Asian health activity. The utilization of the information in studying the dynamics of accumulating susceptibles provides the West African Programme a greater assurance of its moment-to-moment status than exists elsewhere.

(3) The concept of "eradication escalation" which seizes upon an epidemiological situation of a few cases to promote intensive case identification and outbreak control efforts, is a new concept which is clearly identified with this programme. The last six months have proven the efficacy of this approach, one which is now being adopted in other areas.

(4) The development of a vast regional programme based on vaccination by jet injection is also unique to the West African Programme. This programme has clearly shown that the Ped-O-Jet can be employed as the principal instrument in a mass vaccination programme and has provided an understanding as to the circumstances under which jet injection vaccination should be practiced for greatest efficiency.

(5) Finally, the remarkable degree of international co-operation involved in this regional programme must stand as unique in the history of disease prevention. The countries in West Africa have, for purposes of the fight against smallpox and measles, permitted their borders to be penetrated by teams from adjacent countries, have rapidly exchanged information on the existence of smallpox cases, and have co-ordinated mass campaigns in order to provide the most effective and timely coverage of common borders.

## DISCUSSION

I have discussed the major operational aspects of the Smallpox Eradication and Measles Control Programme. The mass vaccination campaign is now a fact of life in Africa, assessment is being practiced by many but not all countries, surveillance needs much strengthening, and maintenance activities are a still irregular and non-universal part of the programme. Maintenance activities, with continuing assessment, surveillance and epidemic control, will determine whether or not smallpox eradication is permanently achieved. Measles control, furthermore, as we shall discuss, is ultimately dependent on them.

You have virtually achieved the interruption of smallpox transmission, well ahead of schedule; measles control still appears far in the future, if in fact attainable on a regional basis. The maintenance of smallpox eradication and the achievement of measles control will require of all of us greater endurance, persistence, and imagination. The glamour of the mass campaigns will soon be over. The hard, unattractive, but crucial work of maintaining what has been achieved, must now proceed.

Table 1

Most Recent Information Regarding Activities  
Smallpox Vaccination Team

<u>Country</u>	<u>Type Team</u>	<u>Date Last Report</u>	<u>No. Teams</u>	<u>Average Vacc. Per Team Day</u>
Cameroon	Prospection	Feb.	24	+
C.A.R.	Prospection	Feb.	5	+
Chad	Prospection	March	+	+
Congo	Prospection	+	+	+
Dahomey	SM	Jan.	2	1410
Gabon	Prospection	Dec. '68	8	145
Gambia	SM	Feb.	2	163
Ghana	SM	Sept. '68	7	880
Guinea	SM	March	9	1677
Ivory Coast	S <sup>1</sup>	Nov. '68	8	614
Liberia	SM	Dec. '68	6	173
Mali	SM	Feb.	6	- <sup>4</sup>
Mauritania	SM	Feb.	N.A.	N.A.
Niger	SM	March	5	1503
Nigeria	SM	Nov. '68	37	2523
Senegal	SM	Feb.	7	1164
Sierra Leone	SM	March	7	2621
Togo	SM <sup>2</sup>	March	3	1659
Upper Volta	Prospection <sup>3</sup>	March	21	N.A.

+ Data not available on a monthly basis.

1. Measles immunization performed by a separate organization.
2. During January and February, 10-20 special teams using multiple pressure technique averaged 180-375 vaccinations per day.
3. Smallpox vaccination performed by prospection teams, measles vaccination by unipurpose teams.
4. Teams unable to operate due to inoperable trucks.
5. Gambia is presently in the maintenance phase having successfully completed the mass attack phase in Spring 1968.

Table 2

Assessment Activities

<u>Systematic Assessment</u>	<u>Ad hoc Assessment</u>	<u>No. Assessment</u>
Chad	C.A.R.	Cameroon
Ghana	Gambia	Gabon
Guinea	Senegal	Ivory Coast
Liberia	Dahomey*	Upper Volta**
Mali		Congo B.
Niger		Mauritania
Nigeria		
Sierra Leone		
Togo		

\* Just formed an assessment team.

\*\* Assessment teams are planned for FY 1970.

Table 3

Latest Available Data Regarding Vaccination Coverage Figures  
for Countries doing Systematic Assessment

Country	Latest Figures	Percent Vaccination by Age				Total	Take Rates 0-4 Yrs.
		0-4	5-14	15-44	45+		
Chad	February	63	74	83	88	78	100
Ghana	September	94	96	93	80	93	93
Guinea	March	91	94	88	85	90	99
Liberia	November	84	92	88	82	83	100
Mali	January	100	93	94	96	95	NA
Niger	March	82	90	67	26	74	100
Nigeria*	February	91	86	-68	-	77	-
Sierra Leone	March	90	89	80	74	84	100
Togo	February	100	100	100	100	100	99

\*Data for Gombe town, Northeastern State in categories 0-3, 4-14, 15+ yrs.

Table 4

Efficiency of Surveillance in Countries Consistently  
Reporting (to NCDC) Analyses of Reporting Systems

Country	Date Last Report	Number of Reports Requested	Number of Reports Received	Percent
C.A.R.	February	5	5	100
Chad	February	45	44	98
Gabon	December	30	16	53
Gambia	March	128	94	73
Guinea	March	32	10	31
Mali	February	42	38	90
Niger	February	76	49	64
Nigeria				
Kaduna	February	152	76	50
Ibadan	February	72	72	100
Togo	March	75	75	100

FIGURE 1

CUMULATIVE SMALLPOX VACCINATIONS AS RELATED  
TO THE ESTIMATED TOTAL POPULATION

WEST AND CENTRAL AFRICA SMALLPOX ERADICATION/MEASLES CONTROL  
PROGRAM AREA

