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A programme of multiple-antigen childhood immunization in Yaoundé, Cameroon: first-year evaluation, 1975–1976

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The Yaoundé multiple-antigen childhood immunization programme began in November 1975, making it one of the first expanded programmes on immunization operational in Africa. During the first 9 months, more than 22 000 children were immunized against poliomyelitis, measles, tuberculosis, smallpox, whooping cough, tetanus, and diphtheria. Evaluation of the programme showed the following rates of immunization coverage in the target population: 30% for DPT (one dose or more), 27% for poliomyelitis (one dose or more), 27% for BCG, 33% for measles, and 20% for smallpox. Eighty per cent of children received the correct vaccines for their age and vaccination status. Seroconversion to measles vaccine was 89% in those over 12 months of age but only 50% in those between 6 and 11 months of age. The major factor in low immunization coverage was felt to be inadequate publicity. The cost of the programme was estimated to be US $10 920. The cost of immunizing a child completely was estimated at US $1.90. Some logistic problems encountered during this initial year of operation are discussed.

The Twenty-seventh World Health Assembly in 1974 resolved that the World Health Organization should stimulate a major effort to expand childhood immunization programmes, especially in developing countries (*1*). In another resolution in 1976, the Twenty-ninth World Health Assembly noted that many problems remained to be solved in these expanded immunization programmes, including determination of the best immunization strategies, assurance of adequate vaccination coverage and efficacy, and maintenance of the " cold chain ", the system that ensures vaccines are kept cold between storage and use (*2*).

The Yaoundé multiple-antigen childhood immunization programme began in November 1975, making it one of the first " expanded " programmes on immunization operational in Africa. After the first 9 months of operation, from November 1975 to July 1976, the Yaoundé programme was evaluated in order to: (*a*) assess vaccination coverage and efficacy; (*b*) control the quality of operations, including the selection of patients and vaccine wastage; (*c*) identify the characteristics of the population being reached by the programme publicity; (*d*) determine the ability of the programme to prevent diseases, especially measles; and (*e*) estimate the cost of the operation. The results of this evaluation have been used to modify the Yaoundé programme and will be valuable to other urban African centres planning an expanded immunization programme.

BACKGROUND

Yaoundé is the capital and administrative centre of the United Republic of Cameroon. The population has grown from 166 000 at the time of the 1968 census to an estimated 250 000 in 1975. The birthrate is estimated at 45 per 1000 or about 1000 births per month. The population under 5 years of age is estimated at 20.7% or 51 750 children. The population is ethnically mixed. Migration into the city has been a major factor in its growth, and the rate of movement between the city and the countryside remains high.

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Health care in Yaoundé is delivered through a group of five government dispensaries, three civil service and military facilities, a large child welfare clinic of the Service de la Protection Maternelle et Infantile (PMI Centrale), four smaller political party (OFUNC)-sponsored maternal and child health centres, four private mission dispensaries, a large central hospital, two community clinics affiliated with the University Centre for Health Sciences, and numerous traditional healers.

The Yaoundé immunization programme was developed by the Sous-Direction de la Médecine préventive et de l'Hygiène publique of the Ministry of Health with the technical assistance of the Organisation de Coordination pour la Lutte contre les Endémies en Afrique Centrale (OCEAC). The vaccination team was composed of Ministry of Health employees.

From November 1975 to July 1976, the seven-member Yaoundé vaccination team held a total of 96 vaccination sessions at 11 dispensaries and child health centres in Yaoundé. The team visited each centre on a fixed monthly basis, e.g., the first Monday of the month at centre A. The team was responsible for all technical aspects of vaccine delivery, and maintaining the cold chain presented no major problems. The vaccines were transported in commercial cold boxes using frozen " cold-packs ".

The following age schedule of immunization was used for the selection of patients. The chief of the team and two other team members were responsible for selection.

Age	*Immunizations*
6–8 weeks	DPT and poliomyelitis No. 1 + BCG (marker)
1 month later	DPT and poliomyelitis No. 2
1 month later	DPT and poliomyelitis No. 3
9–23 months	Measles and smallpox (marker)

Vaccinations for older children were decided individually, based on vaccination and disease histories and vaccination scars. Children over 4 years of age received tetanus vaccine rather than DPT.

The following commercial vaccines were used:

DPT (diphtheria–pertussis–tetanus): 50-dose vials for intramuscular injection.

Poliomyelitis (trivalent oral poliomyelitis vaccine, Sabin): 100-dose vials.

BCG (lyophilized): 50-dose vials for intradermal injection.

Measles (live attenuated, Schwarz strain): 10- and 50-dose vials for delivery by jet injector (Ped-O-Jet).

Smallpox (lyophilized): 100-dose vials for administration by bifurcated needle.

Tetanus (60 Lf, absorbed): 50-dose vials.

The target group for the programme comprised all Yaoundé children under 2 years of age. However, older children and nonresidents were always vaccinated. Programme publicity was effected mainly by means of the personnel of the vaccination centres, although some radio announcements were made. The team kept records of the total number of vaccine doses given.

During the 9-month period, the team was the major source of childhood immunization in Yaoundé, although some vaccines were available for purchase in local pharmacies. All immunizations by the team were done free of charge.

METHODS

Four evaluation methods were used:

(1) Throughout the 9-month period, team members recorded the vaccinations given.

(2) During August 1976, visits were made by an assessment team to randomly selected households in Yaoundé to assess vaccination coverage.

(3) During July 1976, an independent assessment team visited 10 vaccination sessions to evaluate team operations and the population presenting themselves for immunization.

(4) Continuous active surveillance of measles was maintained.

Vaccinations

At all vaccination sessions, the selection personnel kept records of the number of new vaccinees, returning vaccinees, number of doses of each vaccine given, and (for DPT and poliomyelitis vaccines) whether this was the first, second, or third dose.

Evaluation of vaccination coverage

A two-stage cluster sample, based on the 1969 census figures for Yaoundé, was used to select children included in the study; this was the method described by Henderson (*3*), and previously used in Yaoundé by McBean (*4*). Thirty neighbourhoods were visited by an assessment team and in each a sample of houses was randomly selected. The first 32 children aged between 8 weeks and 35 months encountered were selected.

Identifying information was taken on each child and all vaccination records were examined. The child

was examined for evidence of scars from previous smallpox and BCG vaccinations. Only documented records were accepted as evidence of immunization.

Evaluation of programme operations including selection

An independent assessment team was trained. They visited 10 vaccination sessions and interviewed every tenth mother leaving the vaccination centre. They recorded the age and vaccination status of the child and the vaccinations actually received during that particular session on a standard form. Later, the correctness of selection was determined by the OCEAC epidemiologist.

Selection criteria. Selection of immunizations for each child was based on age and vaccination status. Correct selection decisions were as follows:

(1) Between 1 and 8 months of age, a child should have started his DPT and poliomyelitis series, with BCG vaccine given at the time of the first dose. The series of three DPT–poliomyelitis vaccine doses should have been completed during this period.

(2) Between 9 and 23 months of age, measles vaccine (together with smallpox vaccine) should have been given, even if this necessitated interrupting the DPT–poliomyelitis series. (At one centre, the pediatrician in charge insisted on beginning measles vaccination at 6 months of age.)

(3) After the age of 24 months, selection was based on individual vaccination requirements but measles vaccine should not have been administered. After 4 years of age, tetanus vaccine was substituted for DPT.

Measles immunity and seroconversion. From each child who received measles vaccine, finger-prick blood specimens were collected on to filter paper as described by Mathews (*5*). One month later, an effort was made to revisit the homes of these children to obtain a second blood specimen and to assess scar formation following smallpox or BCG vaccination. Measles haemagglutination inhibition (HI) antibody assays were performed at the Center for Disease Control (CDC), Atlanta, GA, USA by the method reported by Hierholzer et al. (*6*, *7*), using antigen prepared by the Norrby method (*8*).

The titre of the vaccine in representative measles vaccine vials was measured quantitatively to determine the attenuated virus content at the beginning of the programme. During four sessions, partially used diluted vials were collected and sent for titration to the CDC. In addition, at each centre, the number of measles vaccine vials diluted for use and the total number of children immunized was counted.

Characteristics of parents seeking vaccinations. A questionnaire was delivered to mothers to determine how they had learned of the programme, the distance travelled to the centre, the reason for choosing that particular centre, and the means of transport used.

Measles surveillance

Since 1975, cases of measles have been reported by 11 dispensaries around Yaoundé to the OCEAC epidemiologist on a weekly basis by name, age, sex, place of residence, and vaccination status. Before 1975, reporting from the PMI Centrale, the largest single child health facility in Yaoundé, was monitored at OCEAC. As measles is a common, easily recognized disease, clinical diagnoses are accepted without laboratory confirmation.

RESULTS

Vaccinations given

During the 9-month period between November 1975 and July 1976, the Yaoundé vaccination team held 96 vaccination sessions at the 11 regular vaccination centres. Table 1 shows the monthly tally of vaccinations given. An average of 1270 new children were registered on the programme each month, and the number of children returning for vaccination increased dramatically over the year. Overall, 51 522 vaccine doses (all vaccines) were given during 22 736 child-visits, giving an average of 2.3 vaccine doses per child-visit. An average of 4.5 doses of all vaccines were given to each child registered on the programme over the first 9 months. (A completely vaccinated child would have received a total of 9 doses of vaccine.)

Only 5890 measles vaccinations were given. However, during the month of February, a special publicity effort increased measles vaccinations for that month to more than 2000.

Vaccination coverage

Complete vaccination histories were obtained from a random sample of 596 Yaoundé children (Table 2). Overall, 61% of these had never received any immunization. Of the target group aged 1–8 months, only 22.6% and 21.3% had received one dose or more of DPT and poliomyelitis vaccine, respectively. This level of vaccination coverage is supported by the finding of BCG vaccination scars in 20.9% of the age group (BCG vaccine was given to children as a marker of their first DPT–poliomyelitis immuniza-

Table 1. Monthly vaccinations given by the Yaoundé vaccination team between November 1975 and July 1976

Month	New vaccinees	Returning vaccinees	BCG	DPT dose			Poliomyelitis dose			Measles	Smallpox	Tetanus
				1st	2nd	3rd	1st	2nd	3rd			
November 1975	1112	131	663	575	49	82	642	36	79	389	449	–
December	1164	259	745	355	94	22	741	190	69	357	419	–
January 1976	1306	382	603	701	241	75	668	263	119	524	605	39
February	2867	2398	1695	1732	456	265	1971	479	270	2071	1730	525
March	1282	1212	829	832	509	261	903	524	275	615	754	224
April	1129	1703	900	922	648	409	1036	642	424	516	634	306
May	945	1622	839	819	632	436	879	634	463	510	567	268
June	991	1961	978	818	735	598	1018	800	588	470	619	386
July	664	1608	715	470	526	492	620	632	529	438	543	350
Total	11 460	11 276	7967	7224	3890	2640	8478	4200	2816	5890	6320	2097

Table 2. Random sample survey of vaccination coverage, Yaoundé, August 1976

Age group (months)	No. of children studied	Vaccination coverage (%)					
		Never vaccinated	DPT: 1 dose or more	Poliomyelitis: 1 dose or more	BCG: vaccination scar	Smallpox: vaccination scar	Measles
1–8	230	76.5	22.6	21.3	20.9	0.4	0.4
9–23	239	45.5	37.2	33.9	33.1	25.9	32.6
24–35	127	30.0	30.7	25.2	26.8	41.7	48.0
Total	596	60.6	30.2	27.2	27.0	19.6	37.9[a]

[a] Coverage for measles vaccination in those aged 9–35 months only.

Table 3. Random sample survey of DPT vaccination coverage by number of doses, Yaoundé, August 1976

Age group (months)	No. of children studied	DPT vaccination coverage (%)		
		at least 1 dose	at least 2 doses	3 doses or more
1–8	230	22.6	13.9	5.6
9–23	239	37.2	22.8	13.4
24–35	127	30.7	21.3	15.0
Total	596	30.2	20.0	11.9

tion). One-third of the target 9- to 23-month-old children had received measles vaccine. Only one-third of children beginning their DPT–poliomyelitis immunizations completed the 3-dose series during these 9 months (Table 3).

In Table 4, the actual number of immunizations given by the Yaoundé team is compared to a calculation of the projected number of children immunized, derived by applying the percentage coverage figures to the estimated child population of Yaoundé.

Evaluation of programme operations including selection

Selection. Of 196 child records examined, selection decisions were correctly made in 156 cases (80%). Most selection errors, that is, errors in deciding the correct vaccinations for a particular child at the session, involved the use of measles vaccine or the failure to associate measles and smallpox vaccines. Of all measles doses given, 6% went to children under 9 months of age and 12% to those over 24 months.

Marker vaccines. BCG vaccine left a scar in 76 of

Table 4. Number of vaccinations given in Yaoundé compared to projected number of children immunized

Vaccine	Age group (months)	Percentage immunized (coverage survey)	Estimated Yaoundé population	Projected number immunized	Actual doses given by team
DPT	1–23	30.1, 18.3, 9.6 [a]	22 000	13 642	13 754
BCG	1–23	27.1	22 000	6 306	7 967
Measles	9–23	32.6	14 000	4 564	5 890

[a] Coverage for DPT vaccine includes those children given one, two, and three or more doses.

84 children vaccinated (91%). Of 35 children receiving their DPT–poliomyelitis vaccination, 33 (94%) correctly received simultaneous BCG vaccine. Smallpox vaccination left a scar in 26 of 27 children (97%). Of 77 children receiving measles vaccination, 72 (94%) received simultaneous smallpox vaccination.

Vaccine usage. During 5 of the vaccination sessions evaluated, three 50-dose measles vaccine vials and nine 10-dose vials were opened, representing 240 measles vaccine doses. With these vials, 188 children were vaccinated, resulting in an average use of 78% of vaccine doses.

Work load. An average of 240 children were vaccinated at a session. However, at some all-day sessions, more than 400 children were vaccinated over a period of about 7 h.

Measles immunity and seroconversion

During the 10 sessions evaluated, blood specimens were taken from 45 measles vaccinees, of whom 76% were seronegative at the time of selection for measles vaccination (Table 5). Of 21 children located for a follow-up serological examination, 67% showed seroconversion. However, seroconversion in children less than 12 months of age was significantly lower; these children had been vaccinated at the same sessions with the same vaccine. The children had not had clinical measles during the study interval.

Table 5. Measles immune status and seroconversion to measles vaccine in children selected for measles immunization

Age group (months)	Children selected for measles immunization			Seronegative children followed-up for seroconversion		
		seronegative (HI titre ⩽1:10)			Seroconverted	
	No.	No.	(%)	No.	No.	(%)
6–11	26	22	(85)	12	6	(50) [a]
12–35	19	12	(63)	9	8	(89) [a]
Total	45	34	(76)	21	14	(67)

[a] Difference significant, P=0.001, by Fischer's Exact Test.

Measles vaccine titre, as determined on representative vials at the beginning of the programme, was 2.5 $TCID_{50}$ logs per 0.5-ml dose. However, partially used, diluted vaccine vials collected during 4 sessions had titres ranging from 0.5 to 1.5 logs. Although the numbers tested were small, seroconversion did not appear to correlate with these low vaccine titres or with specific vaccination sessions.

Population reached by the programme

During July, 198 persons accompanying children to vaccination sessions were questioned (Table 6). At the 10 centres, an average of 87% of all children were brought for vaccination by their own mothers. Over 40% of parents chose to attend a centre more distant than the one in their area, mainly because they knew the personnel or also went there with the child for curative treatment. Only 18% learned of the programme through radio or poster publicity. More than half of all parents arrived at the centres by some public or private vehicle, despite the high cost. Of these July vaccinees, 10% were children who had arrived in Yaoundé during the previous month.

Measles morbidity

During 1976, 2019 cases of measles were reported in Yaoundé residents through active surveillance at 11 Yaoundé dispensaries. This measles incidence represents a 25% reduction compared to 1975 (2639 cases) and a 30% reduction from the average annual number of cases reported for the years 1973–1975 (3230 cases, see Fig. 1).

Table 6. Responses to a questionnaire: sample of parents leaving vaccination centres

1. Who brought the child to be vaccinated?	
(*a*) Mother	172 (87 %)
(*b*) Other relative	24 (12 %)
(*c*) Other person	2 (1 %)
	198
2. Why was the child brought to this centre for vaccination?	
(*a*) Closest vaccination centre to home	109 (59 %)
(*b*) Personnel known or centre used for health care	51 (27 %)
(*c*) Other	25 (13 %)
	185
3. How did the parent learn of the vaccination programme?	
(*a*) From the personnel of the centre	112 (58 %)
(*b*) From a friend, neighbour, or relative	38 (19 %)
(*c*) From publicity (radio, posters)	35 (18 %)
	195
4. How did you travel to the center for vaccination today?	
(*a*) By foot	89 (47 %)
(*b*) By taxi (CFA frs. 100)	69 (36 %)
(*c*) By bus (CFA frs. 50)	11 (6 %)
(*d*) By private car	21 (11 %)
	190

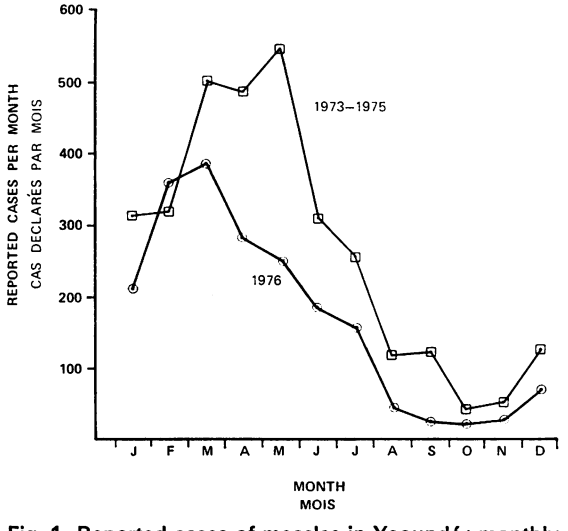

Fig. 1. Reported cases of measles in Yaoundé: monthly averages for 1973-1975 and 1976. The number of reported cases during the period were: 1973, 4439 cases; 1974, 2660 cases; 1975, 2639 cases; average for 1973-1975, 3230 cases; 1976, 2019 cases.

Table 7. Estimate of overall costs for the Yaoundé vaccination programme for 9 months November 1975-July 1976

Item	Costs		
	CFA frs.	US $ [b]	Percentage of total
1. Vaccines	1 289 500 [a]	5200	47
2. Personnel (1 full-time, 6 part-time)	687 500	2752	25
3. Materials and transport	549 000	2200	20
4. Surveillance and evaluation	192 000	768	7
Total	2 718 000	10 920	

[a] This estimates the value of the vaccines if purchased as:

Measles	5 500 doses at CFA frs.	37.5 per dose
Smallpox	6 600 doses ar CFA frs.	5 per dose
DPT	15 000 doses at CFA frs.	17.5 per dose
Poliomyelitis	15 000 doses at CFA frs.	47 per dose
BCG	8 800 doses at CFA frs.	6 per dose
Tetanus	2 200 doses at CFA frs.	15 per dose

However, of these the measles, smallpox, poliomyelitis, and BCG vaccines were donated by foreign governments of international agencies and their cost was not directly incurred by the programme.

[b] Calculated at an exchange rate of CFA francs 250 to US $1.00.

Programme costs

An attempt was made to estimate the overall cost of the Yaoundé programme, despite the fact that some of these costs were not actually incurred by the programme (cost of donated vaccines, for example).

In Table 7, the overall cost for 9 months has been estimated at CFA francs 2 718 000 or US $10 900. The itemized table shows the vaccine to be the major cost (47%) with personnel salaries second at 25%.

In Table 8, the estimated costs per unit programme activity have been calculated. The average cost of a dose of vaccine (CFA frs. 24) is the total cost of all vaccines used, i.e., CFA frs. 1 289 000,

Table 8. Estimated programme costs

	CFA frs.	US $
Average cost of a dose of vaccine	24	0.10
Average administrative cost per dose	28	0.11
Total cost per dose administered	52	0.21
Average cost per child-visit	120	0.48
Average cost per child registered	237	0.95
Projected cost per child fully vaccinated	470	1.90

divided by the number of doses given, i.e., 51 522. The average administrative cost per dose (CFA frs. 28), is calculated as all programme expenses except vaccine cost, i.e., CFA frs. 1 428 000, divided by the number of doses given. The cost per child-visit and child registered are simply the total programme cost divided by the number of children in each of these categories. It is projected that to vaccinate a child fully in this programme would cost CFA frs. 470 or US $1.90.

DISCUSSION

This evaluation provides some data on a multiple-antigen immunization programme in urban Africa and demonstrates the problems to be overcome in the expansion of immunization services in developing countries. Comparisons will be limited to the few published evaluations of mass vaccination programmes and to limited data available from other programmes.

Vaccination coverage

The overall 30% coverage of the target group 1–23 months of age achieved in 9 months in Yaoundé is disappointing. In 1972, a biennial mass measles immunization campaign achieved 78% coverage of the 6- to 36-month-old target population over a 3-month period using intensive publicity (*4*).

Wide coverage, however, was not a primary goal in the early months of programme operation. Since the team was inexperienced and many logistic problems needed to be solved, small vaccination sessions were desirable. Health centre personnel were the main means of disseminating information since they were in contact with the parents who brought their children for baby care or medical consultation. Although attendance did increase in subsequent months, coverage never reached the target; several factors were thought to have contributed to this low vaccination coverage.

First, mass publicity efforts, radio, and posters were inadequate to inform the majority of the community of the new vaccination services. Radio broadcasts were not made at the peak morning listening hours, nor were they made in local African languages. However, it may be that, in general, mothers of young African children do not listen to the radio. The large turnout of children in February, when loudspeaker trucks circulated in the town, indicated that the community was ready to respond when the techniques of mass immunization campaigns were used. However, the Yaoundé programme was never intended to be a mass (attack phase) campaign, and these methods were not felt to be appropriate on a continuing basis. The diversity of ethnic groups and languages made publicity even more difficult.

Second, these newly available immunization services attracted a large number of older children, outside the target age group, who had never received immunizations. This diverted both vaccines and team time away from the target groups.

Finally, as the response to the programme increased, the size of vaccination sessions reached the upper limit of 350–400 children per day. In these large, chaotic vaccination sessions, women sometimes waited 3–4 hours without reaching the front of the crowd. These women became discouraged and did not return to seek immunization for their children.

Thus, in community-based multiple-antigen immunization programmes, vaccination coverage is linked to publicity and to the efficiency with which the programme can meet the demand for immunization services. The Yaoundé programme has been reorganized to simplify the selection of patients, to improve the flow of patients to vaccination stations, and to deliver DPT vaccine by jet injector rather than by syringe and needle.

While pre-programme immunization levels were not documented in Yaoundé, a baseline immunization survey in Douala [a] in September 1976, using the same methods as in Yaoundé, provided some useful comparative data.[b] In Douala, a random sample of 337 children aged 1–23 months was evaluated. Only 19.2% had had any kind of immunization compared to 39.4% in Yaoundé. In Douala, only 7.4% of the target 1- to 8-month-old children had received at least one DPT–poliomyelitis dose, while in Yaoundé 22.6% of this age group had begun the course. Finally, only 9.6% of Douala children age 9 to 23 months had been immunized against measles, compared to 32.6% of Yaoundé children.

Completion of the DPT–poliomyelitis course

Only one-third of children beginning the DPT series completed the third dose during the 9-month

[a] Douala is the major port and commercial city of the United Republic of Cameroon with a population of about 400 000, and is situated about 375 km west of Yaoundé on the Atlantic coast. In Douala, vaccines for children could be purchased in private pharmacies and at some child health centres in an uncoordinated programme such as in Yaoundé prior to 1975. A mobile vaccination team visited the city every 2 years for the mass measles, smallpox, BCG, and yellow fever campaigns.

[b] OCEAC. Evaluation of vaccination services in Douala, Cameroon. Unpublished OCEAC report, 1976.

period. While this low figure is somewhat biased by the short period under study, the return rate is low and disappointing. A special health education effort directed at women first presenting their babies for DPT–poliomyelitis vaccination will need to ensure they understand that the full course comprises three doses. The programme may adopt a more widely spaced two-dose schedule of DPT–poliomyelitis vaccination if and when it is shown to be as effective as the three-dose course.

Programme operations

Selection of patients. Selection decisions were correctly made according to programme criteria in 80% of cases. Of children selected for measles immunization, 76% were seronegative compared to the 1972 mass measles compaign when only 49% of vaccinees were susceptible (*4*). The limitation of measles immunization to the 9- to 23-month-old target group focused immunization on the high-risk group.

Effective vaccine administration. The overall 67% seroconversion to measles vaccine in susceptible children was an improvement over the 40% found by McBean during the 1972 mass campaign (*4*). As expected, seroconversion was age-related: although the numbers tested were small, seroconversion in children under 12 months of age was noticeably lower. Breman (*9*) also found reduced seroconversion in children 6–8 months of age (84.3% compared to 94.7% in children 9–23 months of age). This finding reinforces the need to delay measles vaccination to reduce apparent vaccine failure. In this programme, 9 months was taken as the age at which seroconversion rates were considered adequate and when vaccination would result in at least half of the important risk group under 1 year of age being immunized.

Seroconversion rates did not seem to vary by session, and the low vaccine titres discovered in used vials may have resulted from problems in transporting the vaccine to the laboratory. Smallpox and BCG efficacy were adequate at 97% and 91% scar rates, respectively.

Logistics. In brief, good organization and supervision of a complex operation such as a multiple-antigen immunization programme is crucial. At the time of the vaccination session, all operational elements from transport to supplies, personnel, and organization must be well coordinated if children are to be effectively immunized. In developing countries, where health facilities frequently function with major elements lacking, logistic aspects must be stressed.

Further, the publication of a year-long vaccination schedule should be seen as a commitment to providing immunization services at a given place and time. Success in the operation will depend, above all, on an operations officer who has the technical and fiscal authority to make the programme work. Civil Service policies need to be changed to provide incentives to immunization workers.

Measles surveillance

The ultimate evaluation of an immunization programme is its ability to prevent disease. Although measles incidence in Yaoundé was reduced in 1976, it would be difficult to argue that the level of vaccination coverage achieved by the team was responsible for this effect. Nevertheless, the focusing of vaccination on a precise age group and the timing of the February campaign may have played a role in modifying the pattern of the annual epidemic.

Programme costs

No previous reports exist with which to compare cost figures for a multiple-antigen immunization programme. In Yaoundé, an effort was made to keep costs low by using available materials, vaccines, and personnel. However, the costs shown in Table 7 were estimated as though incurred in the programme.

In the 5-year smallpox eradication and measles control programme in West and Central Africa (1967–1971), about US $31 000 000 was spent to vaccinate about 122 000 000 persons against smallpox and 20 000 000 children against measles. The average cost of the programme was approximately $0.27 per person. Measles and smallpox vaccine purchases accounted for 25% and 10% of the budget, respectively.[a] Clearly, the Yaoundé multiple-antigen programme is more expensive per person vaccinated and the cost of the vaccines represents virtually half of the total budget.

The US $1.90 estimated to vaccinate a child fully is more than the annual *per caput* expenditure on health of many African states (*10*). In Yaoundé, to immunize fully the estimated 12 000 infants born every year would cost about US $24 000. Therefore, multiple-antigen immunization is expensive and means of reducing overall costs must be found, otherwise countries undertaking programmes with foreign assistance will later have to abandon them when faced with bearing the entire cost.

[a] BUCK, A. A. ET AL. Evaluation of the smallpox eradication and measles control program, Central and West Africa. APHA/USAID report, 1971.

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RÉSUMÉ

PROGRAMME D'IMMUNISATION PAR ANTIGÈNES MULTIPLES AU COURS DE L'ENFANCE A YAOUNDÉ, CAMEROUN: ÉVALUATION DE LA PREMIÈRE ANNÉE, 1975-1976

Un programme d'immunisation par antigènes multiples au cours de l'enfance a été entrepris à Yaoundé, République-Unie du Cameroun, en novembre 1975; c'est donc un des premiers programmes élargis de vaccination qui soit opérationnel en Afrique. Après 9 mois, on a évalué le programme afin de déterminer la couverture et l'efficacité de la vaccination, de contrôler la qualité des opérations, y compris la sélection des sujets (triage), et le gaspillage de vaccins, d'identifier les caractéristiques de la population touchée par la publicité relative au programme et d'estimer le coût de ce dernier.

Entre novembre 1975 et juillet 1976, les 7 membres de l'équipe de vaccination de Yaoundé ont procédé à 96 séances, selon un calendrier fixé à l'avance, dans 11 dispensaires urbains de Yaoundé. En tout, 51 522 doses de vaccins (de toutes les catégories) ont été administrées au cours de 22 736 visites-enfants à raison d'une moyenne de 2,3 doses de vaccin par visite-enfant. Une moyenne de 4,5 doses de tous les vaccins a été administrée à chaque enfant enregistré.

L'évaluation de la couverture en ce qui concerne la vaccination a été effectuée sur un échantillon statistique d'enfants de Yaoundé et a montré que, parmi le groupe d'âge cible (1 à 8 mois), seules des proportions de 22,6% et 21,3% respectivement ont reçu au moins une dose de vaccin DTC ou de vaccin antipoliomyélitique buccal. Une cicatrice de BCG a été découverte chez 20,9% des enfants. En ce qui concerne le vaccin antirougeoleux, un tiers du groupe d'âge cible (9 à 23 mois) en avait reçu. Parmi les enfants qui avaient commencé à recevoir leur vaccination DTC-polio, un tiers seulement a reçu la totalité des trois doses.

L'équipe de vaccination a pris des décisions de sélection correcte en fonction de l'âge et de l'état d'immunisation chez 80% de ces enfants. En moyenne, 240 enfants étaient vaccinés au cours d'une séance. Parmi ceux qui ont été retenus pour la vaccination antirougeoleuse, 76% étaient séronégatifs: il y a eu séroconversion, après la vaccination antirougeoleuse, chez 89% des enfants âgés de 12 à 35 mois, mais 50% seulement ont été protégés parmi ceux de moins de 12 mois.

Une évaluation de la population touchée par le programme a montré que 87% des enfants ont été amenés par leur mère. Plus de 40% des parents ont choisi un centre plus éloigné et non celui qui était situé dans leur voisinage. Seulement 18% des personnes ont été informées du programme par la radio ou des affiches, le reste en avait entendu parler directement par des personnes connues et surtout par des membres du personnel sanitaire. Il semble que la publicité de masse n'ait pas donné un résultat satisfaisant.

L'incidence de la rougeole au cours de la période d'évaluation a été réduite de 25% par rapport à l'année précédente.

Le coût global du programme a été de 2 718 000 francs CFA (US $10 900), le coût du vaccin représentant 40% des dépenses et les salaires du personnel 25%. Il a été calculé que l'immunisation complète d'un enfant coûterait 470 francs CFA (US $1,90).

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