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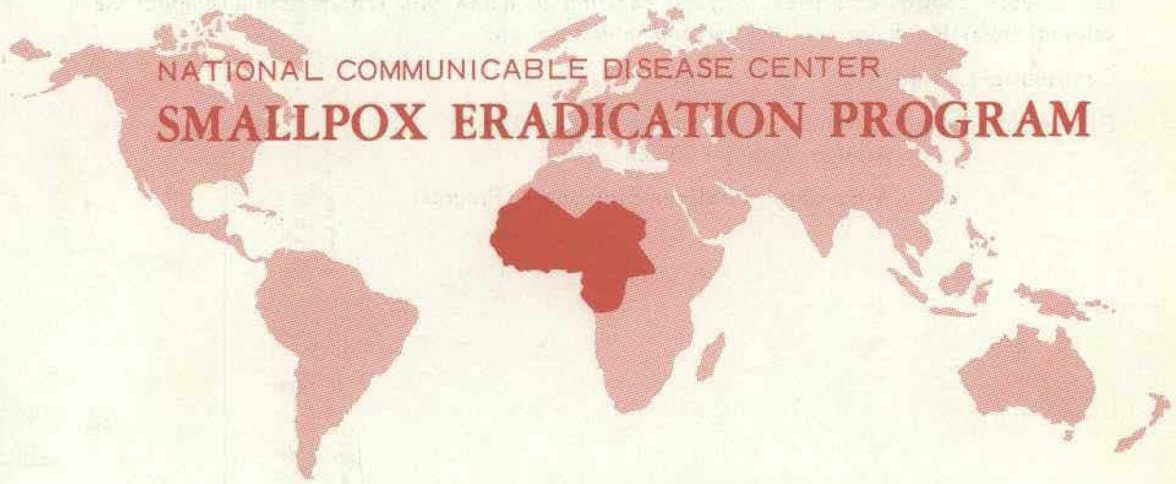


NATIONAL COMMUNICABLE DISEASE CENTER

SMALLPOX ERADICATION PROGRAM

THE SEP REPORT

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE

PUBLIC HEALTH SERVICE

CONTENTS

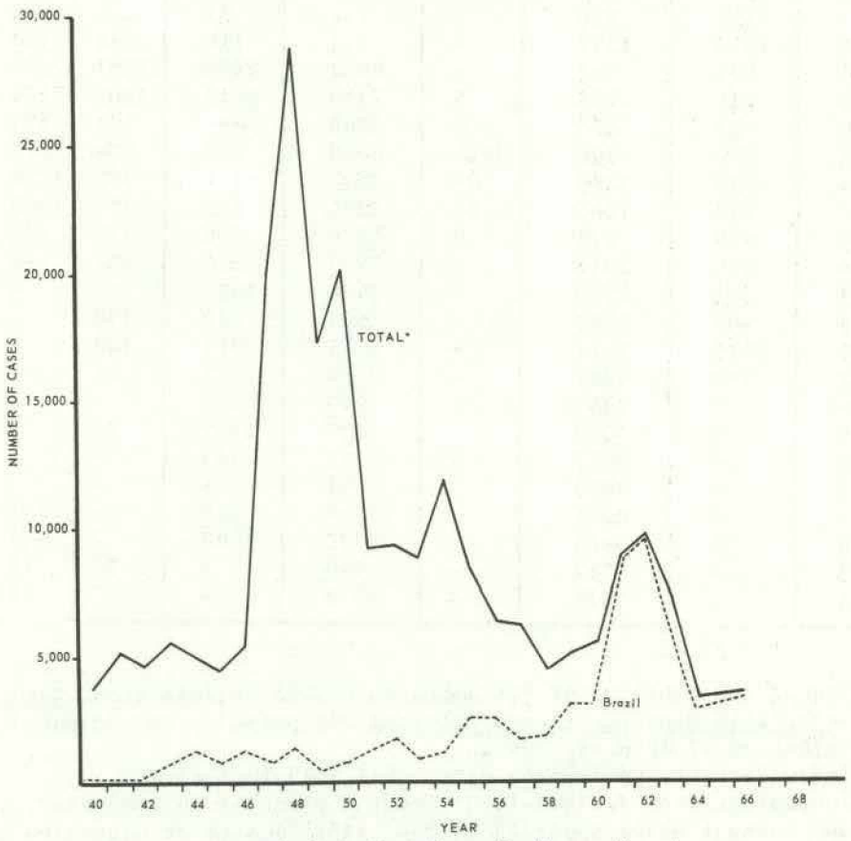
I. SMALLPOX SURVEILLANCE

A. Smallpox in South America -- 1940-1966

Morbidity Trends

The occurrence of reported smallpox from 1940 to 1966 for major South American countries* is depicted in Figure 1.

FIGURE 1. REPORTED CASES OF SMALLPOX FOR 10 SELECTED COUNTRIES* OF SOUTH AMERICA, 1940-1966

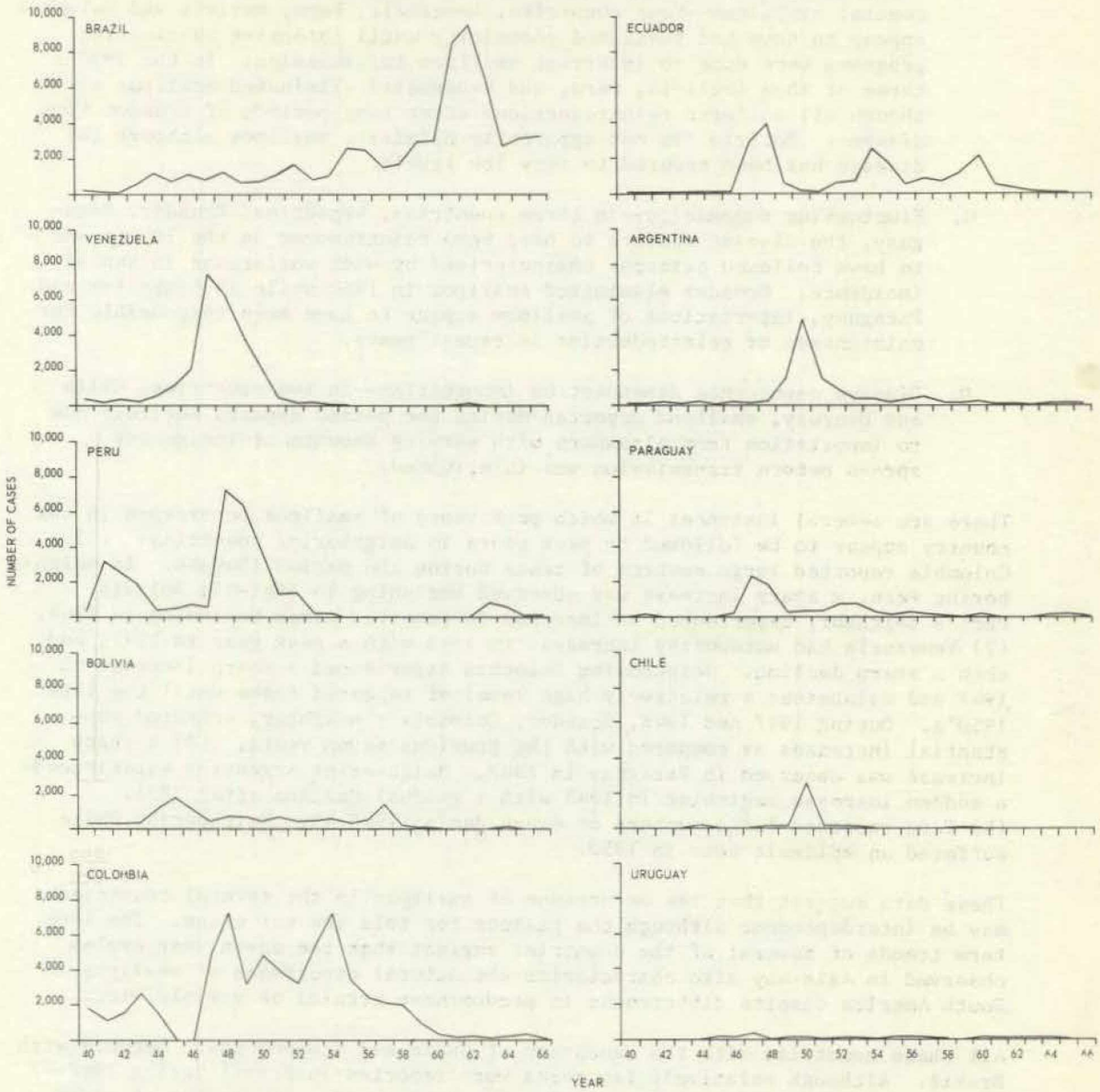


*Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, Paraguay, Peru, Uruguay, and Venezuela.

Table 1 and Figure 2 present these data by country. Since 1940 all countries have experienced epidemic years.

* Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, Paraguay, Peru, Uruguay and Venezuela.

FIGURE 2 REPORTED CASES OF SMALLPOX BY COUNTRY, SOUTH AMERICA, 1940–1966



The geographic distribution of cases in four recent years is shown in Figure 3. The risks to areas bordering on countries with endemic smallpox is clear. This emphasizes the need of effective smallpox surveillance to rapidly detect and contain introduced disease. The 1963 epidemic in Loreto Department, Peru, is a case in point. Peru was smallpox free for a long period after completing mass vaccination campaign in 1954. In December, 1963, four cases were reported in Lima following introductions from cities in Loreto Department (contiguous to Brazil). A field investigation carried out in October 1964 revealed widespread endemic smallpox in Loreto Department requiring extensive mass vaccination to reestablish effective control of smallpox transmission.

Effects of Vaccination on Disease Occurrence

Data shown in Table 2 and Figure 4 compare the annual case rates of reported smallpox with the proportion of the population vaccinated annually for Brazil, Bolivia and Colombia for the period 1958-66. Vaccination figures are not yet available for the period before 1958 to permit an analysis of the vaccination rates in Peru during the eradication of smallpox in the early 50's.

Table 2. Case Rates and Vaccination Rates* for Brazil, Bolivia and Colombia, 1958-1966

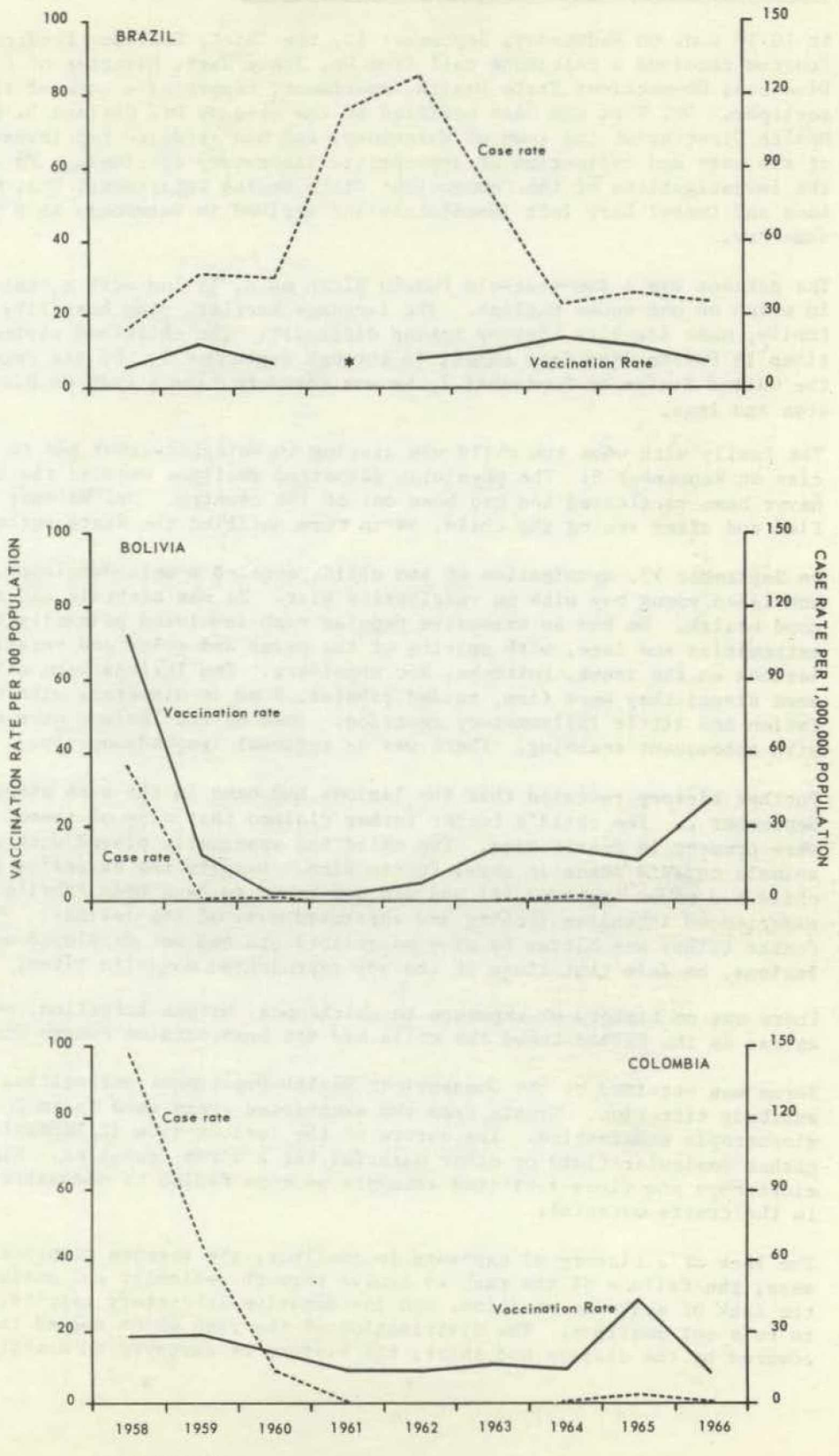
Country	1958	1959	1960	1961	1962	1963	1964	1965	1966
Brazil									
Vaccination Rate	6.6	12.2	7.5	...	8.1	10.4	13.9	11.9	6.8
Case Rate	24.6	46.1	45.8	115.9	126.2	81.3	33.9	38.8	36.3
Bolivia									
Vaccination Rate	72.2	12.4	1.2	1.0	4.6	14.4	14.6	11.3	27.7
Case Rate	54.3	2.0	0.3	-	-	-	1.4	-	-
Colombia									
Vaccination Rate	18.9	19.1	14.1	8.7	9.3	10.6	9.7	29.9	8.7
Case Rate	148.6	68.7	14.8	1.1	2.8	0.3	1.2	3.8	0.4

* Case rate per 1,000,000 population; Vaccination rate per 100 population.

Although an intensive eradication campaign was initiated in 1962 in Brazil, however, the vaccination rate has lingered around 10 perdent of the population per year. Even though the case rate has dropped considerably since 1961 approximately 90 percent of the reported smallpox in South America occurs in Brazil (Figure 1). In contrast, Bolivia initiated a mass eradication campaign in late 1957 and vaccinated 72.2 percent of the population during 1958. The resultant efforts drastically reduced the case rate (per 1,000,000 population) from 54.3 in 1958 to 2.0 in 1959. Subsequent to this the disease was eradicated. Similar observations are evident for Colombia where mass vaccination efforts initiated in 1955 resulted in virtual elimination of the disease by 1961.

(Compiled from Pan American Health Organization annual publications, Reported Cases of Notifiable Diseases in the Americas and personal communications.)

FIGURE 4. CASE RATES AND VACCINATION RATES FOR BRAZIL, BOLIVIA, AND COLOMBIA, 1958–1966



*Data not available.

and the intense itching nature of the lesions suggest multiple infected flea bites as the probable etiology.

(Reported by Dr. James Hart, Director of Preventable Diseases, Connecticut State Health Department; Dr. Garland L. Weidner, Health Director, Waterbury, Connecticut and Chief, Domestic Operations Section, Smallpox Eradication Program, NCDC.)

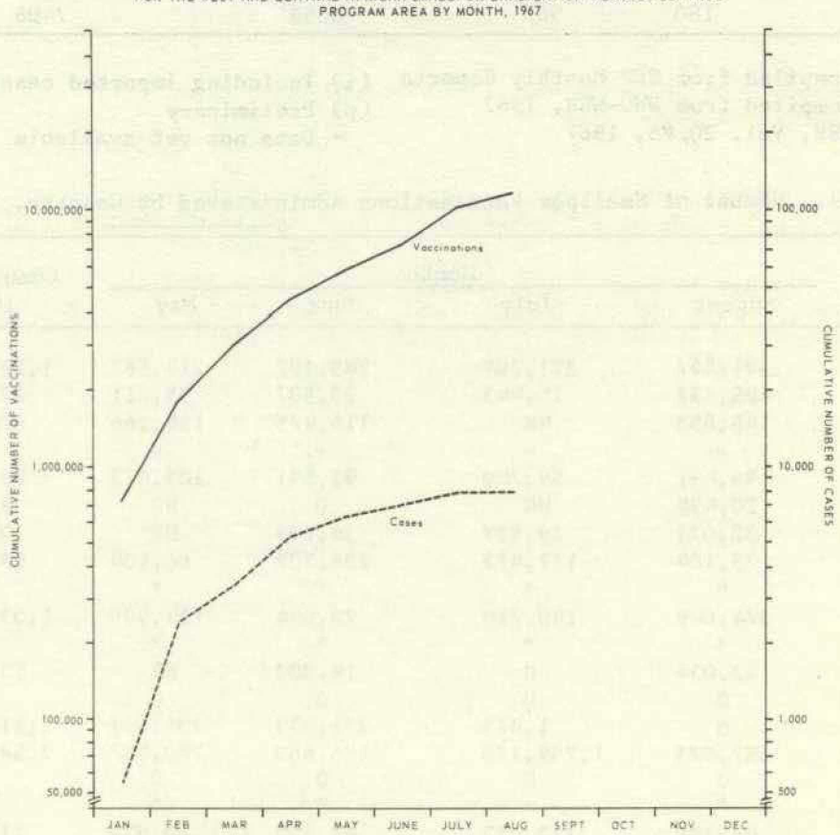
II. PROVISIONAL DATA - WEST AND CENTRAL AFRICA SMALLPOX ERADICATION/MEASLES CONTROL PROGRAM AREA

A. Smallpox Morbidity and Vaccination Data (Provisional)

Figure 5 shows the monthly cumulative distribution of cases and vaccinations for 1967. Through August, 8,053 cases have been reported, which exceeds the 1966 annual total of 7,406. These morbidity data are shown by country in Table 3. Notable epidemics have occurred in Guinea and Sierra Leone.

A total of 11,734,274 vaccinations have been given in the Program area since January 1. Data from individual countries are shown in Table 4.

FIGURE 5. CUMULATIVE NUMBER OF VACCINATIONS AND CASES FOR THE WEST AND CENTRAL AFRICAN SMALLPOX ERADICATION MEASLES CONTROL PROGRAM AREA BY MONTH, 1967



B. Measles Vaccination Data (Provisional)

Table 5 shows that 1,939,664 measles vaccinations have been given during 1967. Country data are also presented in this table.

Table 5. Number of Measles Vaccinations Administered by Country, 1967

Country	August	July	June	May	Cumulative 1967
Cameroon	12,339	63,191	38,562	42,563	188,852
C.A.R.	6,028	3,839	4,268	12,653	54,260
Chad	18,786	NR	19,912	20,140	126,891
Congo (B)	-	-	-	-	-
Dahomey	28,827	15,903	27,528	25,436	122,860
Gabon	3,051	NR	0	NR	16,872
Gambia	6,377	8,295	7,927	0	22,599
Ghana	13,338	23,064	38,026	3,722	89,527
Guinea	*	*	*	*	*
Ivory Coast	0	11,000	13,000	38,674	190,503
Liberia	*	*	*	*	*
Mali	0	0	27,421	NR	154,701
Mauritania	0	0	0	0	0
Niger	0	0	2,021	16,843	115,696
Nigeria	132,842	218,274	4,817	47,237	463,170
Senegal	0	0	0	0	0
Sierra Leone	*	*	*	*	*
Togo	12,437	19,001	16,328	4,663	133,313
Upper Volta	8,000	0	35,077	44,487	260,420
Total	242,025	362,567	234,887	256,418	1,939,664

* Smallpox Eradication Programs have not been instituted in these countries as of August 31.

III. ERADICATION NOTES

A. West African Markets - Their Use in Assessing Vaccination Coverage

The Role of Markets

In many societies in West Africa, markets serve the economic function of buying, selling and trading. In addition, they serve very useful functions as nodes in the network of communications existing in a society. The entertainment value of markets often results in festive performances and palm wine drinking. Finally, markets play a political role in maintaining control over the people in an area.

Types of Market Societies

Marketless societies are not frequently found in West Africa. Peripheral market societies are most frequently found among nomadic groups. In these societies most people are not engaged in producing for market or in selling in markets. The absence of markets would not paralyze the economy.

A sampling interval was selected, based on the total population of the market, which would yield a sample of approximately 500 persons. The sampling unit was defined as the individual stall (all individuals in the stall plus those engaged in business or conversation with those in the stall) or individual seller (and their customers). A market could then be surveyed in two to three hours using two interviewing teams.

The sample population was classified by vaccination status, age and sex in all of the surveys. In addition to this, two of the surveys solicitated data according to where the respondents lived: "local" for those living in the market town; "environs" for those living outside the town but within 20 km of the town; and "de passage" for those living more than 20 km from the town.

Two problems came up during the surveys. The first was the identification of vaccination scars. Although liberal in the readings, it was difficult to know whether certain of the scars were the results of burns or other trauma or were the result of vaccination. Also the readers were unfamiliar with the morphology of the BCG intradermal vaccination scar, although the incidence of these scars in Ivory Coast and Upper Volta is low enough not to have grossly changed the results.

The second problem was the sampling of the children 5-14 years old. These children roam all over the market, and tend not to be caught in the sample as either buyers or sellers. They cluster around the sampling team as curiosity seekers. In addition to the bias introduced by choosing children who have come to "look at the survey team," one cannot be certain of not including the same children several times over. At the last market, just prior to leaving, all children were examined who were following the team. Although the best solution at present, this leaves much to be desired.

The results of the market surveys in Ivory Coast and Upper Volta were quite similar and showed uniformly high rates of coverage (89-91%) in the 5-14 and 15-44 age groups. The coverage of the under 1 age group in both countries was almost universally below 40 percent. In the 1-4 age group, an overall coverage of 73 percent was seen in Ivory Coast, while the coverage in Upper Volta was 62 percent.

Table 6. Combined Results of Market Surveys in Ivory Coast (Treichville, Bouake, Ferkessedougou and Bouafle)(Sample taken from measles vaccination site rather than Market) and Upper Volta (Bobo-Dioulasso, Pouytenga and Kombissiri), 1967

	Ivory Coast		Upper Volta	
Age	Total Persons	Percent Vaccinated	Total Persons	Percent Vaccinated
<1	62	36	59	34
1-4	132	73	92	62
5-14	192	91	149	90
15-44	843	89	1121	89
45+	42	81	165	62
Total	1271	85	1586	83

SUMMARY

In summary, three generalizations are evident from these survey data. First, the age distribution is skewed toward the older age groups as compared with the age specific percentage distribution of the West African population (1965 U.S. Demographic Yearbook). Secondly, scar rates among market populations were notably lower in the pre-school age groups. Children under the age of one had a low scar rate, children between the ages of 1 and 4 had higher scar rates, but even this group had scar rates of 10 to 20 and more percentage points below the 5 to 14 age group. Thirdly, market surveys showed a preponderance of males in the 15-44 age group.

While these surveys are initial attempts and the clear-cut methodology has not yet been defined such surveys might possibly prove to be an extremely useful assessment tool. It is with considerable interest to the assessment activities of the program that similar surveys be carried out in other countries. Current plans are being developed to conduct routine assessment surveys and market surveys simultaneously through which comparison of results can be made. The market survey is to be studied and evaluated as to its validity and applicability.

(Reported by Ralph H. Henderson, M.D., Epidemiologist, Regional Office, Lagos, Nigeria, and Acting Evaluations Officer, NCDC, Smallpox Eradication Program. Reference text; Markets in Africa, edited by Paul Bohannan and George Dalton, Northwestern University Press, 1962.)

B. International "Cross Notification" of Interrelated Smallpox Outbreaks

A 6-year-old Yoruba male arrived in Sabari (Yendi District, Northern Region, Ghana) on July 2, 1967, from Shaki in Western Nigeria. He developed fever on July 6 and a smallpox rash on July 9. Scabs and sera were obtained on the fifteenth day of illness. The sera revealed an HI titer of 1:512.

The patient was isolated, contacts were vaccinated and placed under surveillance and mass vaccination in Sabari was initiated.

A 2-year-old Yoruba girl arrived in Bobo-Dioulasso, Upper Volta on June 18, having left Shaki on June 14. She developed fever on June 21, and a smallpox rash was seen on June 27. Vaccination of contacts was accomplished, and no secondary cases have been reported.

In both cases reports were forwarded to Nigeria. The rapid notification to Nigeria is to be commended. When properly developed cross notification could materially hasten the attainment of regional eradication.

(Reported by Ministry of Health, Ghana and Ministry of Health, Upper Volta and NCDC Smallpox Eradication Program personnel.)

C. "Morbidity and Mortality" of Trucks and Jet Injectors

An analysis of problems experienced with trucks and jet injectors in the field is summarized in Table 9.

Problems with the clutch system and axles appear to be primary factors causing down time for vehicles. The down time of vehicles has been kept to a minimum as a result of superb efforts on the parts of their users. Many minor problems have occurred without prohibiting the use of the vehicle. Among these are problems with breaking fan belts, weak shock absorbers, weak front springs, malfunctioning gauges, and leaking cabs.

IV. EPIDEMIC INVESTIGATIONS

A. Lake Chad Area - Chad

Introduction

An epidemic of smallpox was brought to the attention of health officials on June 28. A physician, an English missionary, had been in the northern tip of Lake Chad and initially reported 14 cases of smallpox including 3 deaths. Smallpox has not been reported in the area for the past two years.

Geographically, the area consists of thousands of small "floating islands" which dot Lake Chad as viewed from the air. The islands are matted networks of papyrus plants and other weeds, with long dangling roots. They are insecurely attached to the bottom and often drift for miles. For varying lengths of time Boudouma fisherman occasionally live on the islands and tend to migrate across the Lake which ranges from one to 30 feet deep.

Initial Cases

Case #1 was a 28-year-old female who had traveled to the village of Bolorum from Dourmandi, Nigeria. After leaving Dourmandi around May 12, she and her husband traveled overland and reached Bolorum around May 28. She became ill with headache, fever and myalgia around May 30. A few days later she developed a pustular rash on her face, arms and legs.

On June 15 her 14-year-old daughter, Case #2, developed a mild illness with a few pustules on her arms and legs but none on her face. Case #2 had been vaccinated eight years prior to onset of disease.

Case #3, a 3-year-old female, had onset of disease on July 1. The third case, Case #1's youngest daughter, had a generalized eruption.

An aunt of this family, Case #4, who had been living with them became ill around July 1. She developed fever with pustules about her face and died three days later.

Two non-family members had also lived with them but had recently moved to the village, Ayerom. One of these persons, an elderly woman, had contracted the disease (Case #5) and died on July 6.

Control measures were instituted in both Bolorum and Ayerom with 98 people being vaccinated. Eighty-three of these were primary vaccinees. Also, a continuing search for additional cases was maintained. The search produced Case #6, the husband of Case #1 who had been living in the village of Soro and died with an "eruption all over his body" on July 4(?). The immediate circle of contacts was vaccinated with the single exception of one girl who did not attend the clinic because she "wasn't feeling too good." She was located and examined by the SEP physician and diagnosed as having classical smallpox with pustules from head to toe.

Observations revealed that during the control activities of the investigation, villages having more than 500 inhabitants were relatively well vaccinated (about 80 percent with previous scars) and smaller villages were poorly vaccinated (about 20 percent with previous scars).

After departing from the village Soro, cases were discovered in several other villages: nine previously reported cases from two villages called Gala N'Goutaula and Gala Goa; eight new cases with two deaths were found in the

The subsequent epidemic investigation demonstrated that the smallpox outbreak had begun in the city of Luziania (estimated population 6,000) in November 1966. The index case was a 36-year-old female from Orizona, Goias, who attended a small wedding in Luziania. Of eight persons at the wedding, seven were unvaccinated and became ill with smallpox. The eighth person had been previously vaccinated and did not acquire smallpox. From this household the disease spread to the ranch. Among the 24 residents of the ranch, twelve subsequently became ill with smallpox.

The age and sex distribution of 25 cases having occurred in the municipality of Luziania between January 1 and June 22 is presented in Table 12. Sixty-four percent of the cases were less than 15 years of age. Eighteen (72%) of the cases were females. Twenty-three of the 25 cases had never been vaccinated. One of these cases, a 50-year-old female, was vaccinated seven days after exposure. Subsequently, the patient had a mild form of smallpox. The intervals between previous vaccination and onset of disease for the remaining two cases were 10 and 25 years.

Table 11. Smallpox Cases by Age and Sex, Luziania Municipality, Goias, Brazil, 1967

Age Group (Years)	Male	Female	Total
0-4	2	3	5
5-14	4	7	11
15-29	1	4	5
30+	0	4	4
Total	7	18	25

The investigation showed the last known case occurred on June 22. This patient a 16-year-old female was vaccinated on June 7, but did not have a clinical "take." Control measures were instituted in the municipality of Luziania the day she was vaccinated. (The number of vaccinations given has not been reported.) Since a period of 15 days had lapsed between date of vaccination and onset of fever, it is suggestive that the patient was exposed to smallpox after the June 7 vaccination campaign.

Brasilia

In the Federal District (Brasilia), nine cases were clinically diagnosed as smallpox by July 1. Of the nine patients, one resided in Brasilia. She was known to have been febrile on June 22; she visited her family in Luziania between June 5 and 8. The remaining eight cases resided in the town of Formosa, Goias (77 km northeast of Brasilia); however, seven had been in a camp 35 km northeast of Brasilia and one had been in the town of Gama.

Control measures were initiated in Brasilia on June 22 and as of July 1, 286,285 persons had been vaccinated.

(Abstracted from Boletim Semanal de Notificacões de Varíola, Tomo I, Number 5, published by Ministry of Health, Brazil.)

American Hospital Association Study

During 1964 and 1965, a group of hospitals performed employee vaccination programs under the auspices of the American Hospital Association and the NCDC. These hospitals included small and large community hospitals, and large teaching hospitals. The programs were designed to estimate costs, to determine the risk of spread of vaccinia to patients, and to compare different methods of administering the programs. Besides the seven hospitals in the original study, more than twenty other hospitals have provided some data on vaccination programs stimulated by the AHA or NCDC.

To date no instance of spread of vaccinia from employee to hospital patients, even in hospitals where 85 percent of the employees were vaccinated in one or two days, has been reported. Less than one complication per 7,000 vaccinations have been observed; complications have been limited to sore arms from severe takes, and one case of benign generalized vaccinia. Less than one employee-day was lost per 2,000 vaccinations.

Two major types of programs have been used. One type was a "crash" program aimed at vaccinating all susceptible personnel in five days or less. They have generally succeeded in reaching approximately two-thirds of the personnel. When this is added to the approximately one quarter of the employees previously adequately vaccinated, it is evident that such a program can result in 90 percent protection of the staff. Success has also been observed in programs limited to vaccination of all entering employees, plus vaccination of some 20-25 employees each day by appointment. While such programs may take some six months to complete in large hospitals, the results have been satisfactory. Because of the high turnover of employees in most American hospitals, institution of an entering-employee vaccination policy should be a part of all programs, and may in fact be sufficient in some hospitals.

One of the poorest responses was observed in one hospital which charged a minimal fee for immunizations and required a consent slip signed by a physician. Less than 20 percent of the employees responded to this program. A nurse should be able to adequately screen for contraindications to vaccination. Routine vaccination should be provided free as a part of good employee health practices. Vaccine can usually be obtained from State or local health departments without loss to the hospital.

Two features of many of the programs completed to date are felt to be useful but not necessary for an adequate campaign. First, surveys to determine the need for hospital immunizations are not necessary; they help provide propaganda for campaigns, but it can be assumed that there is a need for a campaign without carrying out a survey. Second, "take rates" need not be determined. If the vaccine used is a lyophilized vaccine, and good technique is employed, take rates will be acceptable and the vaccinations need not be read.

On the basis of the findings in these programs, the American Hospital Association has made an official recommendation for vaccination of hospital workers. A brochure[4] has been published which details the methods of doing a hospital vaccination program. This brochure contains sections on:

A. Essentials of gaining support before undertaking a campaign.
B. Essential steps in conducting a survey of the current vaccination status of personnel who work in the hospital.
C. Essentials of administrative preparation for undertaking a vaccination program.
D. Essentials for carrying out the program.

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STATE EPIDEMIOLOGISTS – USA

Key to all domestic smallpox surveillance activities in the United States are those in each State who serve the function as State epidemiologists. Responsible for the collection, interpretation and transmission of data and epidemiological information from their individual States, the State epidemiologists perform a most vital role. This major contribution in continuing a constant smallpox vigilance is gratefully acknowledged.

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