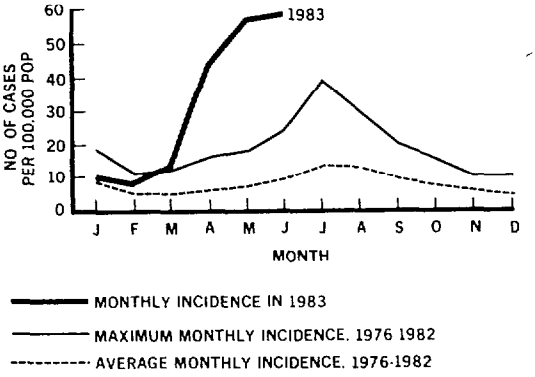
INVESTIGATION OF A MEASLES OUTBREAK IN BRAZIL'S FEDERAL DISTRICT

In April 1983 Brazil's Federal District of Brasilia registered an unusual increase in the number of reported measles cases (Figure 1). Preliminary analysis of the cases showed they were evenly distributed in all eight administrative regions of the Federal District, an area occupying 5,771 km^2 in the central Brazilian plateau and having a total population of nearly 1.2 million inhabitants, nearly all of them (96%) residing in urban areas.

Vaccination data for the previous few years indicated that coverage among children under one year of age was around 70%. In view of the outbreak, Federal District health authorities decided to intensify measles vaccination in the first half of May 1983, targeting children in the age range of nine months to nine years (who accounted for over 70% of all the reported cases). Over 60,000 doses of vaccine were administered in this period, as compared to the roughly 5,000 doses that would normally have been given. By mid-June, however, the incidence of the disease was even higher than before.

Figure 1. The monthly measles incidence in Brazil's Federal District during January-June 1983. (For comparison, the maximum expected monthly incidence and average monthly incidence in the period 1976-1982 are also shown.)



Survey Methods

The persistence of the measles epidemic despite apparently high levels of vaccination coverage led the Ministry of Health to initiate an epidemiologic investigation. Authorities chose Planaltina, one of the Federal District's eight administrative regions (Figure 2), as the site of a random sample survey to determine children's vaccination coverage, their vaccination history by age group, the vaccine's efficacy, and the children's disease history during the outbreak. Planaltina's population (60,000 inhabitants in 1983) and demographic distribution (85% urban) offered excellent conditions for this type of study.

For the purpose of the survey, Planaltina was divided into 244 blocks (clusters) with an average of 37 households per cluster. Thirty clusters were selected for the survey.[1] Health agents used a standard questionnaire to collect information on the outbreak and to search for additional cases that might have occurred during the previous six months. These questionnaires were completed in 997 households (11% of all the Planaltina households) during a two-week period beginning 25 June 1983.

[1]See R. H. Henderson and T. Sundaresan, Cluster sampling to assess immunization coverage: A review of experience with a simplified sampling method, *Bulletin of the World Health Organization* 60(2):253-260, 1982; and *Programa ampliado de inmunizações PAI, Curso sobre planificação, administração e avaliação*, Pan American Health Organization and Ministry of Health of Brazil, Brasilia, 1980.

Figure 2. Administrative Regions of Brazil's Federal District.

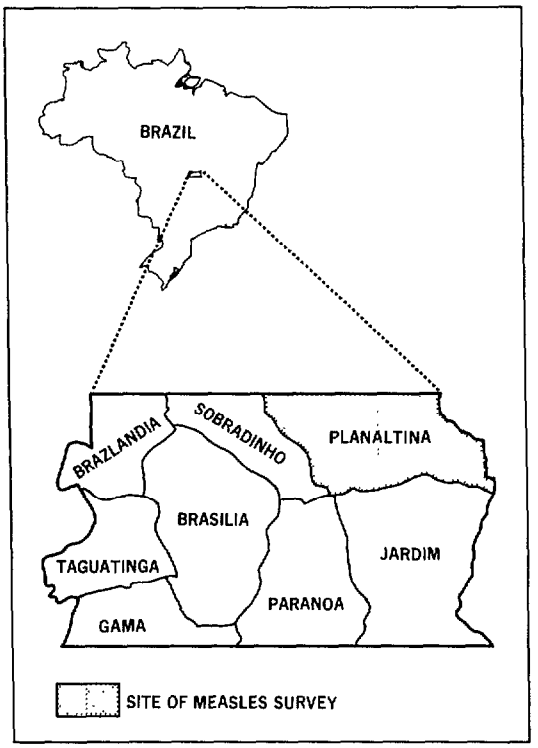


Table 1. Estimated measles vaccination coverage among children less than one year of age in Planaltina, Brazil, 1978-1981.

Year	Coverage (%)
1978	62.8
1979	63.6
1980	75.6
1981	66.5

Table 2. Measles vaccination coverage, by age group, in Planaltina, Brazil, as of 31 December 1982 and 30 June 1983.

Age group	Coverage (%)	
	31 December 1982	30 June 1983
9-11 months	38.2	71.9
1-4 years	77.6	88.1
5-9 years	59.7	80.1
Total	68.4	84.0

Results

Because the increase in measles incidence had begun several months before the survey, it was decided that the survey should cover the first six months of 1983. Accordingly, the survey sought to determine vaccination coverage as of 31 December 1982 (a date considered to mark the beginning of the epidemic) and around 30 June 1983. As shown in Table 1, over 60% of the children under one year old were provided with coverage in each of the years from 1978 through 1981. Coverage of children from nine months through nine years of age had reached nearly 70% by the end of 1982 (Table 2).

A total of 300 cases occurring between January and June 1983 were recorded during the investigation. One hundred and six cases occurred in children known to have been vaccinated, 158 cases occurred in children known not to have been vaccinated, and 36 occurred in children whose vaccination history was unknown. Children under five years of age accounted for 212 (70%) of the cases (Table 3).

Vaccine efficacy was estimated—both for the children who received vaccine before nine months of age and for those who were vaccinated at nine months or later, since before February 1982 the national immunization schedule had called for measles vaccination starting at seven months of age.[2] The following formula was used in making this estimate:

[2]In 1973 the Ministry of Health lowered the recommended age for measles vaccination, first to eight months and subsequently to seven months, in an attempt to control the incidence of measles cases in children under nine months of age. The strategy did not have the desired effect, however, and in February 1982 the recommended age for vaccination was raised to nine months.

Table 3. Number of measles cases, by age group and vaccination history, in Planaltina, Brazil, January-June 1983.

Age group (in years)	Vaccinated		Not vaccinated	Vaccination history unknown	Total
	< 9 mos.	≥ 9 mos.			
< 1	–	4	57	–	61
1-4	56	21	51	23	151
5-9	19	6	29	11	65
10-14	–	–	15	–	15
≥ 15	–	–	6	2	8
Total	75	31	158	36	300

$$VE = \frac{\text{AR in unvaccinated children} - \text{AR in vaccinated children}}{\text{AR in unvaccinated children}} \times 100$$

where VE = vaccine efficacy and AR = attack rate.

The data showed that vaccine efficacy was only 43% for children vaccinated before nine months of age, while it was 83% for children who were vaccinated later. Of the 300 measles cases investigated, 61 (20%) occurred in children less than one year of age. Of these 61 cases, 39 (64%) occurred in children less than nine months of age, and 57 (93%) occurred in unvaccinated children.

Although the total vaccination coverage of children nine months to nine years of age went from 68.4% to 84% between 31 December 1982 and 30 June 1983, the survey showed that coverage of children who had not previously had measles only increased from 50% to 55.4%. This explains why the increased measles vaccination effort was not effective in stopping the outbreak.

The sources and sites of transmission were identified for 30 of the 61 cases occurring among children less than a year old. In all but two cases the sources of infection were children over a year old (Table 4); transmission usually occurred in the child's own household, in a neighboring household, or in a hospital or polyclinic (Table 5).

Table 4. Ages of people infecting 30 subjects less than one year old in January-June 1983.

Age of source of infection	No. of cases	% of cases
9 months[a]	1	3.3
9-11 months[b]	1	3.3
1-4 years	18	60.0
5-9 years	4	13.3
≥ 10 years	6	20.0
Total	30	100

[a]Resident of same household.
[b]Resident of neighboring household.

Table 5. Site of transmission of measles infections to 30 children less than a year old in January-June 1983.

Site of transmission	No. of cases	% of cases
Neighboring household	14	36.8
Same household	12	31.6
Hospital or clinic	8	21.1
Visitor	3	7.9
Day care center	1	2.6
Total	38	100

Control Measures

The intensified measles vaccination effort that began in May 1983 was not effective in controlling the outbreak, despite the large number of doses applied and the high rates of coverage that already existed. The number of children successfully immunized against measles was considerably lower than that indicated by the December 1982 vaccination coverage figures, however, since the majority of children had received their vaccinations before reaching nine months of age, when vaccine efficacy was quite low. Moreover, the mass vaccination in May did not produce a significant increase in either vaccination coverage or immunity, since many of the children covered had already been vaccinated or had had measles.

In response to these findings, the Ministry of Health recommended as an immediate measure that measles vaccine be administered simultaneously with polio vaccine during the national polio immunization day on 13 August 1983. This plan was put into effect for the whole Federal District, and a total of 62,756 children nine months to four years of age (2,416 in Planaltina) were vaccinated at that time.

Source: Pan American Health Organization, *EPI Newsletter* 6(3):1-3, 1984, and *Boletim Epidemiológico* (Rio de Janeiro) 15(16):129-137, 1983.

AN ANALISIS OF LEPROSY INCIDENCE BY PATIENT AGE AND THE CLINICAL FORM OF THE DISEASE

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Descriptive studies on leprosy epidemiology have shown that the incidence of leprosy varies according to its prevalence, and that the following points are particularly worth noting:

1) In high-prevalence regions a large proportion of the cases occur among children and adolescents, whereas in low-prevalence regions the proportion of cases among children and adolescents is very small, with older age groups accounting for a relatively large share of the cases *(1, 2)*.

2) In high-prevalence regions, paucibacillary forms (tuberculoid and indeterminate Mitsuda-positive) clearly predominate over multibacillary forms (dimorphous and lepromatous) and potential multibacillary forms (indeterminate Mitsuda-negative). In contrast, multibacillary forms predominate over paucibacillary forms in low-prevalence regions *(2)*.

3) Regardless of the local leprosy prevalence, paucibacillary forms tend to predominate among young patients, while the proportion of multibacillary forms is greater among individuals who contracted the disease at more advanced ages *(3, 4)*. This suggests that for purposes of epidemiologic analysis, the age of the subjects involved and the clinical form of the disease should be assessed together.

Certain other observations pertaining to the immunology and transmission of leprosy have long been accepted as true by leprologists and epidemiologists. Among these are the following:

1) The greater part of the population (a proportion estimated at close to 80%) is potentially resistant to leprosy and is capable, in contact with the antigen, of developing cellular immunity against *Mycobacterium leprae*. The development of cellular immunity is manifested by a positive response to the Mitsuda test. About 20% of the population is incapable of developing this

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