

chloroquine. A decreased *in vitro* susceptibility to the drug was apparent in four isolates, one of which was associated with an infection pattern compatible with an RI level of resistance. These latter findings do not constitute an absolute demonstration of chloroquine resistance. They do, however, indicate a need for further field studies to monitor the response to chloroquine of *P. falciparum* in Haiti.

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LEPROSY IN THE AMERICAS

Historically, leprosy is or has been decidedly cosmopolitan. Indeed, small numbers of cases (some 15,000) still persist in eight countries of Europe. However, today more than 90% of all known leprosy cases in the world are concentrated in tropical and subtropical regions (1, 2).

In the Americas, the study of pottery and Inca and pre-Inca mummies has given no indication of lesions compatible with the pathology of leprosy. One is led to believe, therefore, that *Mycobacterium leprae* was introduced into the New World by colonists and emigrants from Europe.

Despite its lengthy history, leprosy is still perhaps the least known of the main infections affecting humans. Its diagnosis is still a matter of discussion, its pathogeny is not clearly defined, and its mode of transmission is uncertain.

With the advent of dapsone in the 1940s, it was thought that the leprosy problem would be solved quickly. However, forty-odd years later the number of cases worldwide is over 11

million, and in the Americas alone the number is estimated at approximately 480,000. The problem is made more serious by the fact that some 5% of the cases now present primary or secondary resistance to dapsone (3). Other circumstances that underscore the importance of the disease as a public health problem:

- Leprosy is a chronic disease with severe forms that tend to worsen with time and constitute sources of contagion for life.
- More than a third of the untreated and advanced cases show physical disabilities that worsen with time and result in permanent deformities or mutilations. These disabilities mainly affect the extremities, the face, and the eyes, rendering sufferers totally unfit for work and unable to participate in social activities.
- The disabilities and deformities caused by leprosy have fostered a belief among many, including health workers, that the disease is incurable. The degree of ostracism resulting from this attitude is such that even the sufferer believes that his exclusion from the community is justified; a similar feeling is shared by his family.

Epidemiologic Situation

Leprosy is endemic in all the countries and territories of the Americas except for mainland Chile and certain limited areas in other countries. Table 1 summarizes the data PAHO has received from the countries and territories of the Region (mostly relating to 1982) on registered or estimated cases.

The existing information does not reflect the true epidemiologic picture, owing to the limitations of the countries' data-gathering and recording systems. Most countries have not standardized the data collected from different levels of the health care system; and almost all keep patients permanently on their active registers, even those in good health and those who have died. This is mainly for lack of standardized criteria defining a leprosy case. In addition, a lack of knowledge about the disease and the manner in which the problem is assessed have together led to an underrecording of cases in nearly all the countries.

For this reason, in order to estimate the current number of cases, a scale of percentages ranging from 125% to 300% (equivalent to increases from 25% to 200%) has been applied to the total number of known cases in each country, in accordance with the degree of development of their respective control programs and the coverage achieved in case detection (4).

Among the Southern Cone countries, Paraguay is the one with the highest estimated prevalence (2.5 cases per 1,000 inhabitants); and, as is usually true elsewhere, the geographic distribution of the cases is not uniform. Most patients are concentrated in the eastern provinces—including the capital city of Asunción.

In Argentina, epidemiologic surveillance of the disease has improved considerably in recent years. Most of the patients live in or acquire their cases in the northeastern provinces (Chaco, Córdoba, Entre Ríos, Santa Fé).

Uruguay's endemic western provinces (Paysandú, Salto, and Artigas) adjoin the most seriously affected areas of Argentina.

Table 1. Registered and estimated cases of leprosy in the Americas: The situation in 1982 or in the most recent year for which data are available.

Country or territory	No. of cases		Estimated rate ^a per 1,000 population
	Registered	Estimated	
Anguilla	5	10 ^b	1.1
Antigua (1981)	47	94 ^b	1.2
Argentina	12,198	18,297 ^c	0.6
Bahamas (1981)	36	72 ^b	0.3
Barbados	33	66 ^b	0.2
Belize (1971)	1	10 ^d	0.0
Bolivia (1981)	1,842	3,684 ^b	0.6
Brazil (1981)	180,380	315,665 ^e	2.6
Canada	185	370 ^b	0.0
Chile ^g	19	29 ^c	0.0
Colombia (1980)	20,669	31,004 ^c	1.0
Costa Rica	606	1,061 ^e	0.5
Cuba	5,716	8,574 ^c	0.9
Dominica	16	32 ^b	0.4
Dominican Republic	5,002	8,754 ^e	1.5
Ecuador	2,333	4,666 ^b	0.5
El Salvador (1980)	31	93 ^h	0.0
French Guiana (1971)	957	1,436 ^c	27.1
Grenada (1981)	33	66 ^b	0.6
Guadeloupe (1981)	1,340	2,010 ^c	6.1
Guatemala (1980)	354	708 ^b	0.1
Guyana	547	1,368 ⁱ	1.5
Haiti (1980)	484	1,452 ^h	0.3
Honduras	223	446 ^b	0.1
Jamaica (1979)	796	1,194 ^c	0.5
Martinique (1981)	1,176	1,764 ^c	5.7
Mexico	16,054	28,095 ^e	0.4
Montserrat	5	10 ^b	0.8
Nicaragua (1981)	116	232 ^b	0.1
Panama	147	221 ^c	0.1
Paraguay	4,755	8,321 ^c	2.5
Peru (1980)	3,359	10,077 ^h	0.5
Saint Lucia (1981)	236	354 ^c	3.0
St. Kitts/Nevis (1981)	23	46 ^b	0.8
St. Vincent and the Grenadines	45	90 ^b	0.9
Suriname (1973)	2,311	5,778 ⁱ	13.1
Trinidad and Tobago	367	551 ^c	0.5
Turks and Caicos Islands (1981)	18	36 ^b	6.0
United States	4,330	5,413 ^f	0.0
Uruguay	625	1,250 ^b	0.4
Venezuela	14,746	18,433 ^f	1.2
Total	282,166	481,832	

^a0.0 indicates a rate below 0.05.

^b200%

^c150%

^dEstimate: 10 cases.

^e175%

^f125%

^gEaster Island only.

^h300%

ⁱ250%

In Chile, an unusual epidemiologic situation prevails in that no autochthonous cases have been notified. The prevalence data given in Table 1 refer to Easter Island, located some 5,000 km off the Pacific Coast. The 19 registered cases represent a prevalence of nearly 1% among the Polynesian inhabitants.

In Bolivia, leprosy apparently does not propagate itself in the Andean area or on the cold and dry Bolivian Altiplano (in the departments of Oruro, Potosí, and part of La Paz), even though environmental and personal sanitation is unsatisfactory and the population density is high. However, the situation is different in the northeast, where the climate is hot and humid.

In Peru, most cases are found in Amazonia (the departments of Loreto and San Martín), mainly in the area of the Ucayali River and its tributaries. The prevalences probably are similar to those in the neighboring areas of Brazil (Amazonas and Acre states). Other less active foci have been identified in the highlands, in Apurímac Department (5).

In Ecuador, leprosy is limited almost entirely to the Pacific coastal region (the provinces of Guayas, Los Ríos, El Oro, and Bolívar). In the Andean highlands there are few reported cases.

Further north, however, Colombia registers about half of its recorded cases in the Andean area, the main foci being located in the southeast branch of the Andes. There are municipalities in Santander Department that have recorded prevalences exceeding 2% (6). Significantly, many of the Colombian cases are contracted above 2,000 meters.

Venezuela has the highest recorded morbidity in the Andean area, but it also has the best-organized case-finding system. The geographic distribution of the cases is not uniform, with a higher frequency occurring in the Andean region (a continuation of the southeast branch of the Andes) and in the southeastern plains (in the states of Apure and Barinas).

Most of the cases registered in the Americas are concentrated in Brazil. That country has about 20% of the Region's population but

nearly two-thirds of the reported leprosy cases. As in other areas, the distribution of the disease in Brazil is not uniform, the estimated morbidity being 0.51% in the Amazon area, 0.35% in the Midwest, 0.25% in the Southeast, 0.15% in the South, and 0.05% in the Northeast.

In Central America, the occurrence of leprosy is relatively rare. With the exception of Costa Rica (which has maintained an efficient case-reporting system), the estimated prevalence is approximately 0.1 cases per 1,000 inhabitants. The main foci are located around the Gulf of Fonseca on the Pacific side of the Isthmus—in the Honduran departments of Choluteca and Valle, the Nicaraguan department of Chinandega, and the Salvadoran department of San Miguel. On the Atlantic Coast the Costa Rican province of Limones and the adjacent Panamanian province of Bocas del Toro have been identified as foci.

In Mexico the prevalence of the disease is considered moderate, but in the mid-Pacific states (Guanajuato, Sinaloa, Nayarit, and Jalisco) the estimated prevalence exceeds 0.1%.

In the Caribbean, Cuba's leprosy problem is most significant in the eastern provinces. The Dominican Republic's highest rates are also found in the east, with 55% of the registered cases living in the capital of Santo Domingo. Haiti appears to have relatively little leprosy; for although the true prevalence is estimated to be three times that indicated by registered cases, the estimated prevalence is only 0.03% (7).

In the remaining countries and territories of the Caribbean, the frequency of leprosy cases varies greatly, the French territories (especially French Guiana) and Suriname being the most affected. Among the English-speaking countries, Saint Lucia and the Turks and Caicos Islands have the highest prevalences. It may be noted that Dominica, which has a relatively low prevalence (0.04%), is located between two other islands with very high prevalences (Guadeloupe and Martinique) (8).

In North America, Canada reported 133

cases as of 31 December 1980 (updated figures are shown in Table 1). Apparently all of these 133 infections were imported from 30 different countries. Four countries (the Philippines, India, Vietnam, and Guyana) accounted for 44% of these imported cases (9).

The United States has an estimated 5,000 cases with some 130 new cases occurring annually. The most important foci are located in Louisiana, Florida, and the states bordering Mexico (mainly Texas and California). There are 4,330 registered cases, 300 of which are hospitalized in Carville, Louisiana. Of 1,432 cases registered between 1967 and 1976, 76% occurred in persons born outside the country, mostly in Mexico and the Philippines; more than half the cases involved the lepromatous form of the disease (10).

Table 2 provides data on reported leprosy cases in 19 countries of the Americas that relate to patient age, the clinical form of the disease, and physical disability. Overall, only 8.7% of the patients were in the 0-14 year age range. About 9% of the patients with registered cases in the 19 countries were reported to have some type of disabling lesion; however, this percentage does not reflect the true picture, since registration of disabilities is irregular and sporadic in almost all of the countries.

Table 3 indicates the degree to which reported cases in 22 countries and territories of the Americas were being controlled in 1982. The definition of "control" varies from country to country, but it has generally been taken to mean regular attendance at a medical facili-

Table 2. Reported data on registered leprosy cases that occurred in childhood, yielded a positive bacilloscopy, or produced second or third degree disability, by country, in 19 countries of the Americas. All of the data (except Colombian data covering 1981) are for the year 1982.

Country	No. of cases notified in 1982 ^a	Patients <15 years of age		Cases yielding a positive bacilloscopy		Patients with degree II or III disability ^b	
		No.	%	No.	%	No.	%
Argentina	946	19	2.0	276	29.2
Canada	37	5	13.5	... ^c
Colombia ^a	900	80	8.9	449	49.9	165	18.3
Costa Rica	21	12	57.1	6	28.6	4	19.0
Cuba	328	9	2.7	130	39.6
Dominica	1	1	100.0	1	100.0	1	100.0
Dominican Republic	305	68	22.3	57	18.7	28	9.2
Ecuador	102	17	16.7	34	33.3	- ^d	-
Guyana	107	45	42.1	24	22.4	6	5.6
Haiti	27	1	3.7	4	14.8	4	14.8
Honduras	9	2	22.2	1	11.1	-	-
Mexico	565	24	4.2	200	35.4	69	12.2
Paraguay	305	13	4.3	189	62.0	54	17.7
Peru	43	10	23.3	30	69.8	4	9.3
Saint Lucia	25	5	20.0	7	28.0	7	28.0
St. Vincent and the Grenadines	8	4	50.0	-	-	1	12.5
Trinidad and Tobago	30	9	30.0	9	30.0	4	13.3
Uruguay	41	2	4.9	17	41.5	15	36.6
Venezuela	375	36	9.6	274	73.1	27	7.2
Total	4,175	362	8.7	1,708	40.9	389	9.3

^aThe Colombian data are for 1981.

^bAccording to the WHO classification.

^c... = Information not available.

^d- = None.

Table 3. The proportion of leprosy cases registered in 1981 or 1982 that were reported as being under control in 22 countries and territories of the Americas. All figures are for 1982 except those from Brazil, Colombia, and Saint Lucia.

Country or territory	Registered cases	Under control	
		No.	%
Anguilla	5	5	100.0
Argentina	12,198	12,198	100.0
Barbados	33	24	72.7
Brazil ^a	180,380	127,626	70.8
Canada	185	185	100.0
Chile	19	14	73.7
Colombia ^a	20,669	16,728	80.9
Costa Rica	606	519	85.6
Cuba	5,716	5,635	98.6
Dominica	16	16	100.0
Dominican Republic	5,002	4,474	89.4
Ecuador	2,333	2,333	100.0
Guyana	547	468	85.6
Honduras	223	200	89.7
Mexico	16,054	12,172	75.8
Montserrat	5	3	60.0
Paraguay	4,755	3,879	81.6
Peru	3,359	828	24.7
Saint Lucia ^a	236	171	72.5
St. Vincent and the Grenadines	45	43	95.6
Trinidad and Tobago	367	320	87.2
Uruguay	625	525	84.0
Total	253,378	188,366	74.3

^a1981 data.

ty by the patient. A patient failing to come in for consultation in over two years has generally been considered "out of control." The introduction of multidrug chemotherapy has created a need to revise these definitions and relate "control" to the regularity of drug ingestion.

Few countries of the Americas—in which incidence rates have been monitored for over 20 years—have had a clearcut decline in leprosy. In Brazil, the number of cases registered is increasing from year to year, in terms of both morbidity and absolute numbers. Even in Cuba, which has an efficient case-detection and supervised treatment program, the incidence of new cases (about 3 per 100,000) has remained practically the same over the past 10 years. Venezuela, the exception, has a leprosy

incidence that has declined by nearly 75% over 25 years.

Integration of Leprosy Control with the General Health Services

Integration of leprosy control activities with basic health services is intended to extend program coverage without adding to program costs. Where it has not been accompanied by meticulous planning, the practical implementation of this strategy has proved disastrous. Nevertheless, these negative results should not be blamed on the strategy itself, but rather on poor organization and planning.

The countries with totally vertical programs are faced with problems of high cost, and their specialized services' capacity to extend case-detection and treatment activities to the groups that need them is limited. This situation is apparent in both urban and rural areas. The problem is aggravated by the need to apply combined and supervised chemotherapy in conjunction with the necessity of decentralizing treatment in order to bring it to the patients' homes.

A strategy integrating leprosy control activities with the general services has been put into practice in some countries of the Caribbean (including Cuba), in Costa Rica, and in Brazil. Colombia and Mexico are in a transitional stage. In certain countries (Peru and Ecuador) the experiment has resulted in failure owing to deficient implementation, while in the Dominican Republic a new experiment is underway that seeks to integrate the leprosy and tuberculosis control programs. By and large, however, acceptance of this strategy is still a goal to be achieved in most of the Region.

Treatment

The traditional leprosy treatment method based on self-administered monotherapy is now largely ineffective due to the prevalence of primary and secondary dapsone resistance, which has increased considerably over recent

years. Worldwide, cases of dapsone resistance have been identified in 25 countries where monotherapy has been employed for over 20 years (11).

This situation threatens to wipe out the limited progress achieved in the past 30 years and underscores the urgency of taking steps to deal with the problem, such as adopting a multidrug chemotherapy that will control the generation of *M. leprae* strains resistant to dapsone and the problem of bacterial persistence.

The WHO Study Group on Leprosy Chemotherapy recommends application of new therapeutic regimens with associated drugs for all cases, both multibacillary and paucibacillary. It also recommends that the drugs be administered to the patient under the direct supervision of a health worker. This will require decentralization of treatment to the vicinity of the patient's home, and so will require a sufficiently extensive health infrastructure to apply supervised treatment in rural areas and in the areas around urban centers. At the same time, carefully planned education of the patient and his family members is vital in order to ensure their regular and continuing cooperation with the treatment effort. This new approach thus has very significant ramifications calling for resource mobilization on a larger scale, changes in personnel training, and integration of the leprosy program into both the primary health care services and the basic health services.

Leprosy Research

In combating the disease, priority should be given to the following kinds of research studies (12):

- Prevalence studies, including sample surveys, to measure the magnitude of the problem and its various dimensions—including the distribution of the disease by age group, sex, contact status, geographic location, etc. The criteria for diagnosis, classification, and control of the disease need to be standardized. The irregular distribution of leprosy justifies designing appropriate sample surveys.
- Studies of incidence in certain sectors to identify risk factors, vulnerable groups, and disease

trends. The resulting information would be valuable for future vaccine trials.

- Studies on the pathogenesis of leprosy in different regions, especially on the development of the multibacillary and other evolutive forms, and also on factors that promote development of multibacillary forms from other forms.

- Studies on the effect of treatment with various medications, utilizing prevalence and incidence studies covering a specific period of time, especially among younger age groups. When the means are available to identify subclinical infection, the incidence of the infection ought also to be studied.

- Studies on transmission, especially in connection with attack rates between contacts under different conditions, and factors that influence transmission from contacts.

- Studies on the interaction between leprosy and environmental mycobacteria.

- Epidemiologic studies on resistance to medications, with emphasis on the ineffectiveness of drugs for cases resistant to medication.

- New analyses of all the available data from BCG trials, including small-scale studies on selected groups, such as contacts, to ascertain whether there is a common profile of protection against leprosy. Case studies with a control group could also help determine the value of the BCG vaccine in other sectors.

The results of both serologic and cutaneous tests make it seem likely that reliable immunologic instruments will be available in the near future. Therefore, an inventory ought to be drawn up of the studies that should be made once these instruments are available. Such studies should include:

- studies on the correlation between the infection and the disease under different conditions;
- studies to identify the groups for whom the risk of contracting lepromatous leprosy is high;
- studies on the development of different types of leprosy under differing conditions;
- studies to demonstrate endogenous reactivity and to test the hypothesis of leprosy reinfection.

In addition, there are similarities, differences, and interactions between tuberculosis and leprosy that are not fully understood. Therefore, the epidemiologic interactions between tuberculosis, leprosy infection, and the leprosy disease state must be explored, together with the immunologic function of other mycobacterial infections.

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YELLOW FEVER VACCINATION IN THE AMERICAS

Yellow fever (YF) continues to be a major threat in endemic areas of South America and in adjacent areas where the virus may reappear even after long intervals of quiescence. In the Americas, this disease primarily affects workers engaged in forest activities. The last cases of urban YF documented in the Region were recorded in Brazil in 1942, although there is evidence that urban transmission took place during the 1954-1955 outbreak in Trinidad. Outbreaks in recent years in the vicinity of certain South American towns infested with *Aedes aegypti* have raised great concern regarding the possible urbanization of jungle yellow fever.

Vaccination Programs

Vaccination is the only effective method of protecting man against jungle YF, and the 17D strain of YF virus is now used almost exclusively for vaccination against the disease. The first 17D vaccine field trials were con-

ducted in Brazil in 1937. Following these trials, which showed that a practicable, safe method of large-scale immunization against YF was available, several South American countries initiated vaccination programs. As a result, in subsequent years these countries observed a significant reduction in the number of YF cases.

Routine Vaccination

Some countries maintain routine vaccination programs in areas where jungle YF is endemic. The criteria for selecting these areas is based on the occurrence of cases of the disease; forested areas with monkeys and vectors are also taken into account by certain countries. The latter criterion seems justified, since YF has reappeared in some places after a dormant period of two or more decades.

Good vaccine coverage is hampered by the size of the endemic area, which covers practically half of South America. Operational