

Leprosy (Hansen’s Disease)

Leprosy is a Class C Disease and is reportable to the state within five business days.

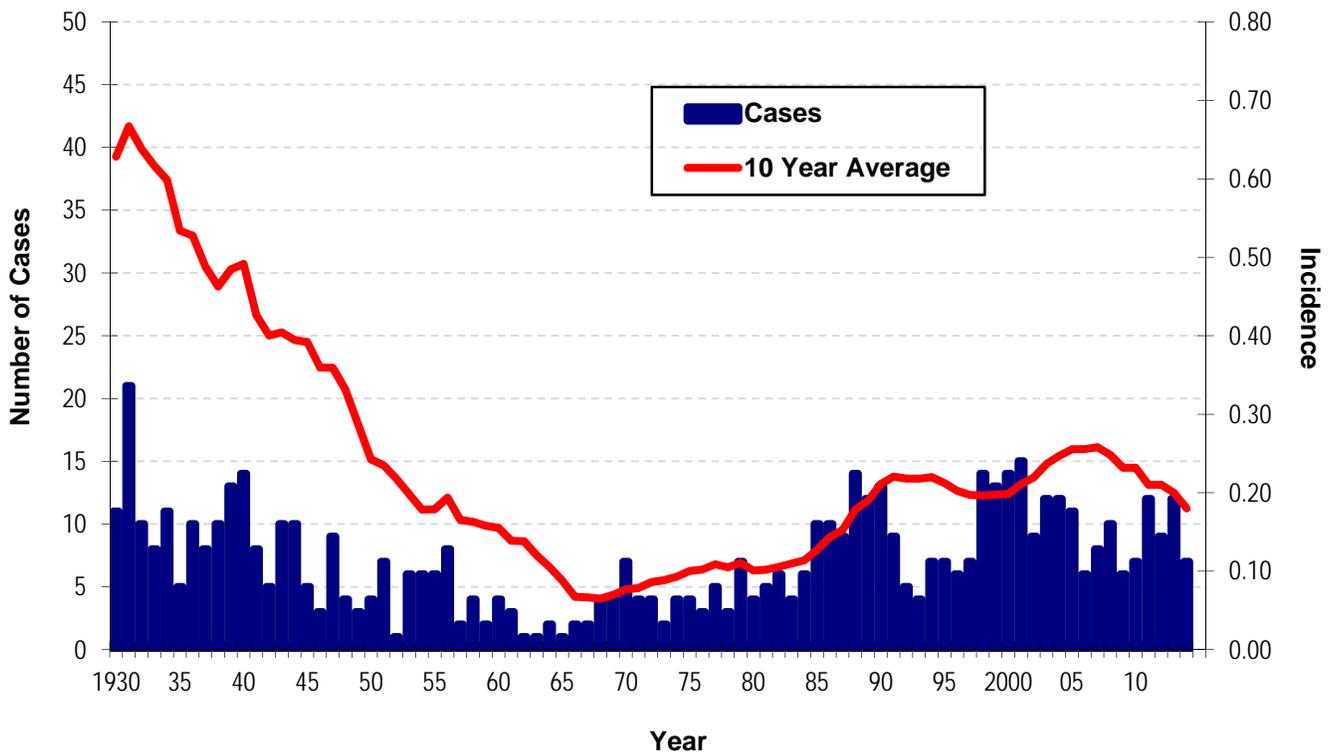
Leprosy was well established in Louisiana prior to the arrival of the Acadians. In the late 1700s, the migration of Acadians from Nova Scotia to Louisiana seems to have imported a few more cases of leprosy. It is only by the late 1880s that the numbers were high enough to cause the Louisiana State Board of Health to found a leprosy hospital at Carville near Baton Rouge. By 1921, the hospital was taken over by the U.S. Government.

Incidence rates (new case registrations) of leprosy increased to the 1880s (4.5/100,000) to reach a high of 12 per 100,000 in the late 1920s. These high rates were observed in South Louisiana (often named “French” Louisiana and New Orleans). North Louisiana was relatively spared with rates rarely exceeding 1.0 per 100,000.

Incidence

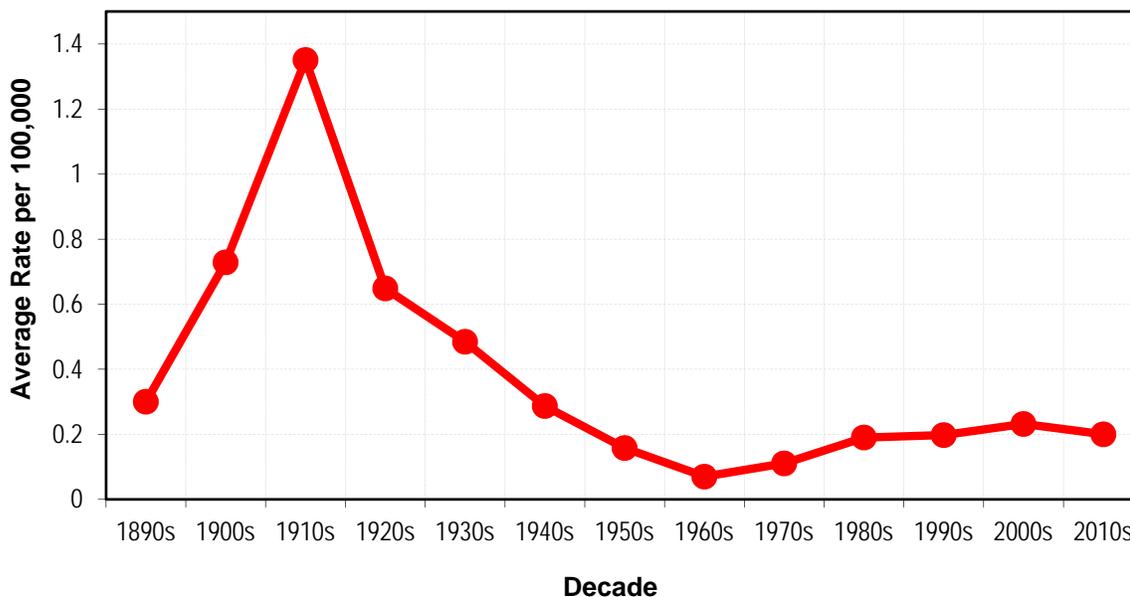
Incidence rates for leprosy from 1880 to 1930 ranged from five to ten per 100,000 in “French Louisiana”. Trends from 1930 to 2014 are presented in Figures 1A and 1B.

Figure 1A: Leprosy cases and 10-year average incidence rates - Louisiana, 1930-2014



From the 1930s to the 1960s the number of new cases and incidence decreased progressively from about 0.5 per 100,000 to 0.2 per 100,000. Case numbers then were approximately five to ten new cases per year for an incidence of approximately 0.1. Starting in the 1960s, the number of cases increased progressively to 10 to 15 per year for an incidence increasing to 0.2 to 0.4 per 100,000.

Figure 1B: Leprosy incidence rates by 10-year periods – Louisiana, 1890s-2010s

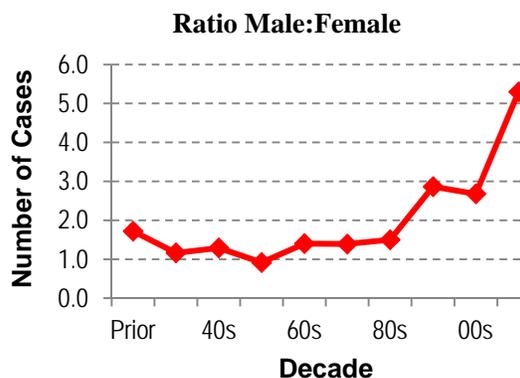


Incidence by Sex

There has been a slight excess of leprosy among males from the earliest report (Table 1); however, the preponderance of males has increased since the 1990s. This type of shift is not usually expected and may reflect a shift in exposure patterns.

Table 1 & Figure 2: Trend in sex ratio of leprosy cases by decades - Louisiana, 1930s-2000s

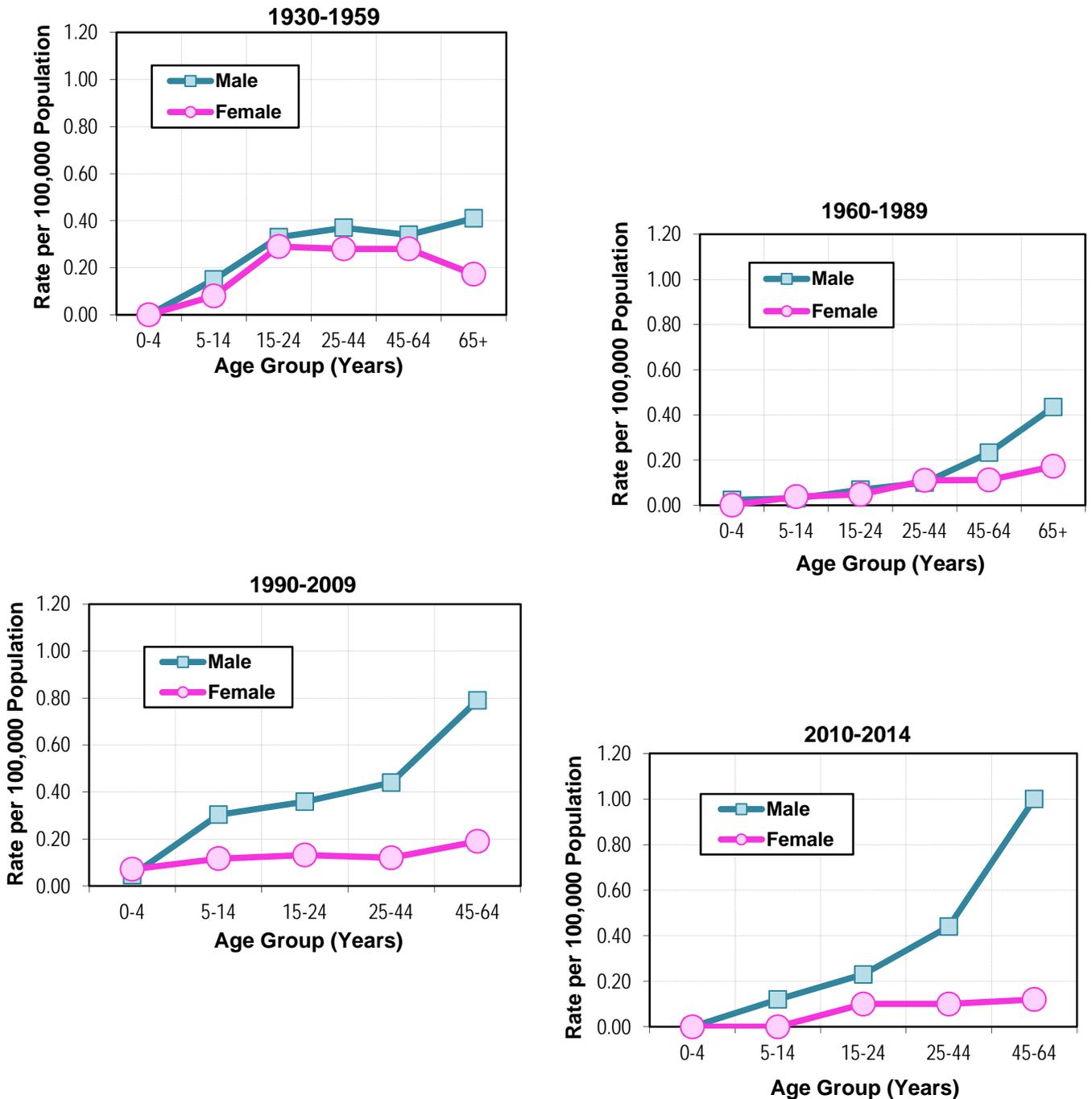
Decade	Sex Ratio		Ratio M:F
	M	F	
Prior	296	172	1.7
1930s	57	49	1.2
40s	40	31	1.3
50s	22	24	0.9
60s	14	10	1.4
70s	25	18	1.4
80s	48	32	1.5
90s	63	22	2.9
2000s	75	28	2.7
10s	42	8	5.3



Incidence by Age Group

Since it appears that there were some shifts in the incidence pattern by sex and age group, the data was analyzed for four different periods: 1930 to 1959, 1960 to 1989, 1990 to 2009 and 2010-2014 (Figures 3A, 3B, 3C and 3D).

Figures 3A, 3B, 3C and 3D: Average annual incidence rate of leprosy by sex and age group Louisiana 1930-2014



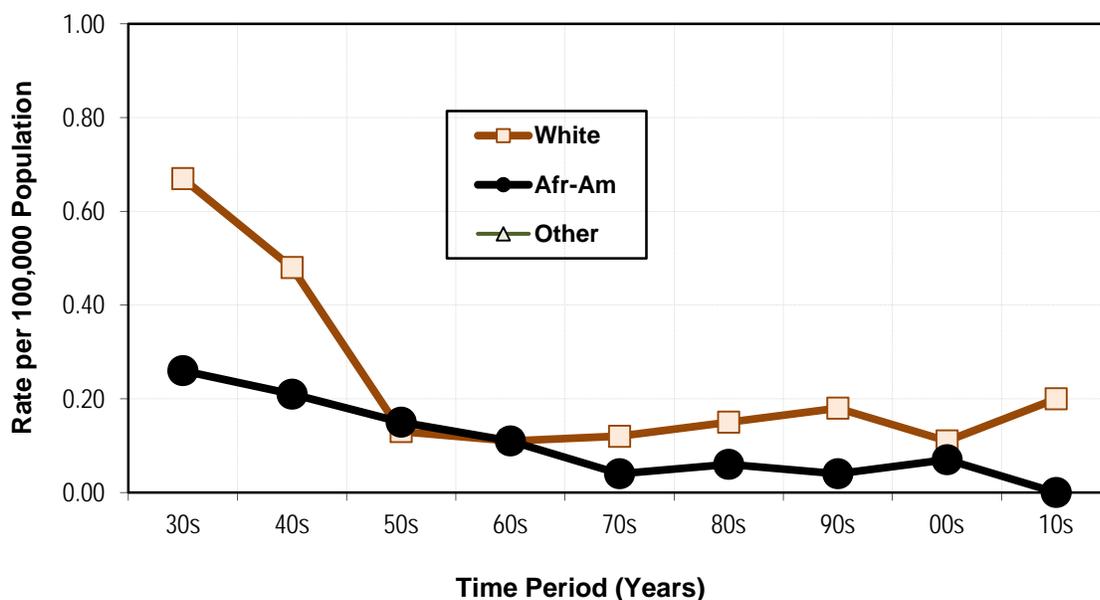
Incidence rates are lower among children and increase with age. That pattern is observed throughout all four periods.

The incidence pattern by sex and age group has changed over time. In the first period (1930-59), there was very little difference between males and females until old age. In the second period (1960-89), by age 45, males start to show higher incidence than females. Finally in recent times (1990-2010), male incidence is much higher than females, much earlier in life. Male children in the age group of five to 14 years, already show higher incidence than female children.

Incidence by Race / Ethnic Group

Throughout the charted time periods (decades), Whites were a majority of cases (77.0%) followed by African-Americans (19.6%). Other groups are rarely represented: Hispanic, 1.6%; Asian /Pacific Islander, 1.6%; Other, 0.2%. There has not been much significant change in the distribution of cases throughout these time periods, (e.g. from 73% to 77% for Whites), (Figure 4).

Figure 4: Incidence of cases by race - Louisiana, 1930s-2010s



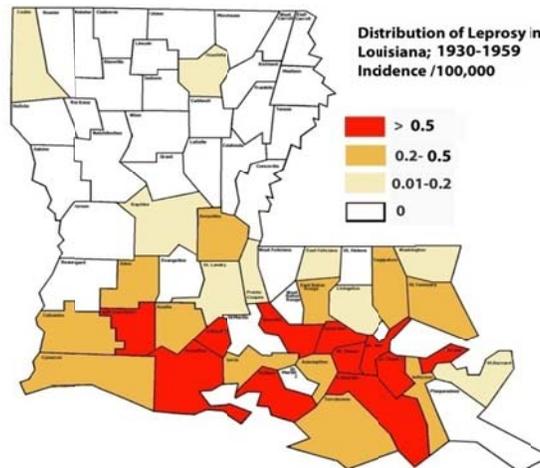
The incidence among Whites has been much higher than that of African-Americans. Incidence has been decreasing in both groups. However, there still remains a gap between both groups.

Geographical Distribution

Leprosy occurred mainly in southern Louisiana in the years between 1930 to 1959. The highest incidence rates were observed in a narrow band of parishes from Orleans Parish in the east to Calcasieu Parish in the west with the highest incidences (0.5 per 100,000 population) being observed in the “Cajun” parishes.

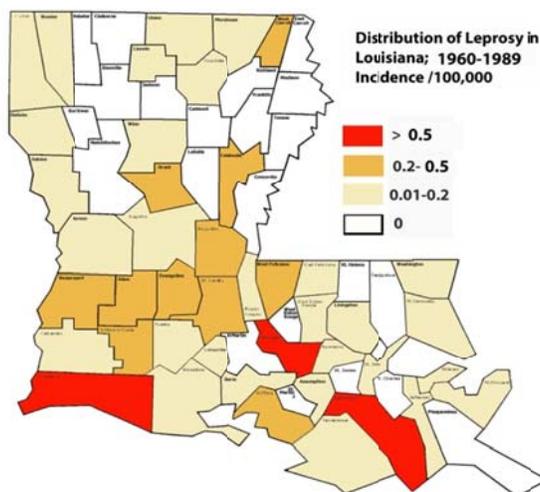
In northern Louisiana, cases were restricted to a few larger cities (Shreveport, Monroe and Alexandria), (Figure 5).

Figure 5: Distribution of Leprosy - Louisiana, 1930-1959



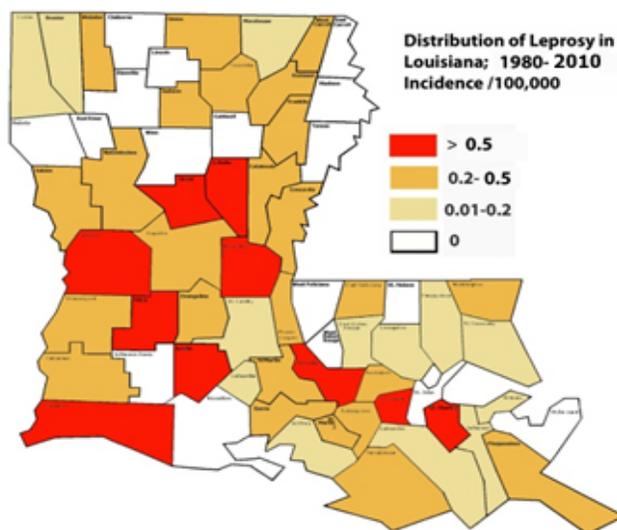
Between 1960 to 1989, there was a sharp decrease in incidence in the “Cajun” parishes; most incidences there had decreased to 0.2 to 0.5 per 100,000 population. Meanwhile, the northern parishes saw a moderate and widespread increase in incidence (0.02 to 0.2 per 100,000 population), (Figure 6).

Figure 6: Distribution of Leprosy - Louisiana, 1960-1989



In the decade from 1990 to 2009, there was a radical change in geographical distribution. Leprosy was on the increase throughout the state, in the Cajun parishes, and particularly in North Louisiana. Several authors had noticed this trend towards leprosy cases in northern Louisiana where it was rarely observed before (Figure 7).

Figure 7: Distribution of Leprosy - Louisiana, 1990-2009



Origin of Cases

The majority of cases are U.S. born (from 2000 to 2014: 94% were born in the U.S.).

Table 2: Country of origin of leprosy cases - Louisiana 2000-2014

	Total	2000-04	2005-09	2010-14
UNITED STATES	90	52	43	42
BRAZIL	1	1	1	0
INDIA	1	1	0	0
TAIWAN	1	1	0	0
VIETNAM	1	1	0	0
WESTERN SAMOA	2	2	0	0
Total Foreign born	6	6	1	0

Only one of these cases was diagnosed before entry into the United States; all others were diagnosed after entry.

Clinical Classification

The distribution of cases by clinical type has changed over time.

- Until the 1950s, the great majority of cases was lepromatous (87%). The proportion of lepromatous cases has decreased since then to average 54%. The proportion ratio is 1.60, confidence interval 1.45-1.77, p<0.0001.

-The proportion of indeterminate cases started to increase progressively in the 1960s, indicating a tendency to making the diagnosis at earlier stages (Cochran Armitage χ^2 for trend 49.9, $p < 0.0001$).

Table 3: Clinical classification of leprosy cases over time - Louisiana, 2000-2010

ALL	I	T	B	L	Sub	Unspec	Total	I	T	B	L
Before	0	39	1	214	254	218	472	0.0%	15.4%	0.4%	84.3%
1930s	0	7	0	98	105	1	106	0.0%	6.7%	0.0%	93.3%
1940s	0	8	0	62	70	1	71	0.0%	11.4%	0.0%	88.6%
1950s	0	23	0	22	45	1	46	0.0%	51.1%	0.0%	48.9%
1960s	1	5	6	11	23	0	23	4.3%	21.7%	26.1%	47.8%
1970s	2	12	11	17	42	0	42	4.8%	28.6%	26.2%	40.5%
1980s	5	17	6	44	72	8	80	6.9%	23.6%	8.3%	61.1%
1990s	4	16	6	55	81	8	89	4.9%	19.8%	7.4%	67.9%
2000s	8	19	2	51	80	17	103	10.0%	23.7%	2.5%	63.8%
2010s	3	4	18	13	38	4	42	7.9%	10.5%	47.3%	34.2%

The distribution of leprosy clinical types by gender shows a preponderance of lepromatous cases for both males and females with the same pattern before and after the 1940s:

-Males: before 1940s = 89% L, after 1940s = 65% L, proportion ratio 1.37, CI 1.24-1.52

-Females: before 1940s = 83% L, after 1940s = 51% L, proportion ratio 1.34, CI 1.34-1.95

The distribution of leprosy clinical types by age group

-Leprosy is very rare under the age of five years.

-Indeterminate leprosy ranges from 2% to 10% in all groups

-Lepromatous leprosy is the most common among all age groups: The comparison of the distribution Lepromatous versus Not Lepromatous by age group (excluding the newborn to four-years old age group) shows no significant difference ($\chi^2=3.97$, $p=0.40$).

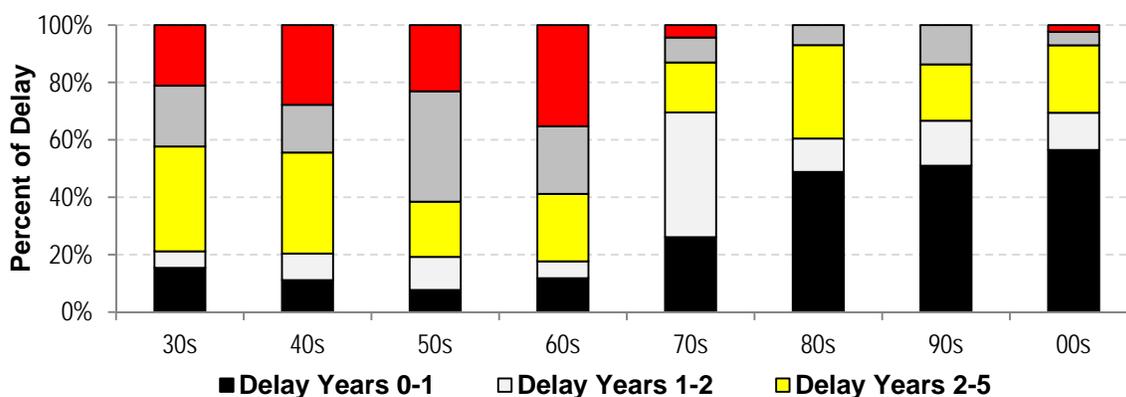
Table 4: Clinical classification of leprosy cases by age group (years) - Louisiana, 2000-2014

HDClass	0-4	5-14	15-24	25-44	45-64	65+	Total
I	0	4	0	2	9	5	20
T	0	1	7	10	8	15	41
B	0	2	0	6	15	18	41
L	0	0	2	24	32	56	114
Total	0	7	9	42	64	94	216
HDClass	0-4	5-14	15-24	25-44	45-64	65+	Total
I	x	57.1%	0.0%	4.8%	14.1%	5.3%	9.3%
T	x	14.3%	77.8%	23.8%	12.5%	16.0%	19.0%
B	x	28.6%	0.0%	14.3%	23.4%	19.1%	19.0%
L	x	0.0%	22.2%	57.1%	50.0%	59.6%	52.8%
Total	x	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Delay Onset-Diagnosis

From 2000 to 2014, the majority of cases were diagnosed within one year of onset (55%). The delay between onset and diagnosis has been steadily reducing throughout the last 80 years. In the 1930s, 40% of cases were diagnosed within two to five years of onset and 20% more than 10 years after onset. The proportion of cases diagnosed within one year was hovering about 10% until the 1970s when it started increasing to be 55% in current times. In the early days, there was no treatment; physicians likely delayed diagnosis because of the consequences to the patient of social ostracization. Mandatory institutionalization in the United States stopped only in the 1960s and outpatient treatment began. Those factors may have affected the diagnosing trends in Louisiana (Figure 8).

Figure 8: Trend in delay between onset and diagnosis by decades - Louisiana, 2000-2008



The Armadillo Connection

In the old days, leprosy was a very focal infection. Most cases were clustered in families or small population groups with very few sporadic cases. This pattern has been changing. Currently, the majority of cases had no family history of leprosy and occurred as sporadic cases with no connection to any cluster. The changes in gender, age group and geographic distribution all tend to show that the epidemiologic picture of leprosy is completely different.

In 1975, a leprosy-like infection was found among the nine-banded armadillo *Dasypus novemcinctus*. This was later shown by DNA studies to be identical to human leprosy. Areas with the highest rates of human leprosy were also areas with a high prevalence of leprosy in the armadillo population. Leprosy research on armadillos started in 1968, however, surveys of frozen specimens of armadillos showed that as early as 1961, armadillos were infected (17/182 positive sera) on a wide scale. Numerous surveys have since been carried out show that about 4% of armadillos had histo-pathological leprosy lesions and 16% had detectable IgM antibodies.

It appears that the prevalence rate among armadillos remained constant throughout the past years. The infection seems to be concentrated to the low-land coastal areas of Louisiana and Texas; only rare cases

were found in higher lands of Texas, Arkansas or Mississippi.

Armadillos are not native to Louisiana. Armadillos slowly expanded their range north from Mexico beginning in the 1880s and have achieved very high densities here. No one really knows what allowed them to extend their range, but people speculate it was the elimination of normal predators as cattle operations increased in Texas. By 1957, armadillos had colonized south Louisiana.

For 32 patients for which armadillo contact was elicited, 15 said that they had contact with armadillos (about 50%). Although the connection between armadillo-leprosy and the changing epidemiology of leprosy in Louisiana is very suggestive, the exact mechanism of transmission is still being debated.