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Public Health Impact of Arthropod- and Rodent-borne Viral Diseases in the Americas[1]

Several arthropod- and rodent-borne viral diseases cause significant public health problems in the Americas. Their impact varies greatly: some are responsible for severe mortality, while others are associated with extensive morbidity, leaving, at times, various sequelae. Three arboencephalitides are also considered major problems in veterinary public health. The following summary of these diseases was prepared for the Meeting of the WHO Scientific Group on Arthropod- and Rodent-borne Viral Diseases, held in Geneva 28 February-5 March 1983.

[1] Prepared by Francisco P. Pinheiro, Meeting of the WHO Scientific Group on Arthropod- and Rodent-borne Viral Diseases (Geneva, 28 February-5 March 1983).

Arthropod-borne Viral Diseases

The distribution of the arboviral diseases in the Americas varies considerably. Dengue is by far the most widely distributed, affecting North America (United States and Mexico), Central America, northern South America, and the Caribbean. Yellow fever is endemic in many countries of South America and has been responsible for epidemics in Trinidad and Bolivia. Although human infection due to St. Louis encephalitis virus occurs in many parts of the Americas, thus far outbreaks of encephalitis caused by this agent have been recorded only in North America. Oropouche fever is a significant public health problem in the Amazon region of Brazil where it has caused extensive epidemics. The best example of an important arbovirus disease of focal

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incidence in the Americas is Rocio encephalitis, which has been recognized only in the coastal region of southern São Paulo, Brazil.

Dengue

All four serotypes of dengue virus occur in the Americas. Extensive outbreaks due to dengue types 2 and 3 were reported in the Caribbean and northern South America in the 1960s and 1970s. Conservative estimates indicate that at least 650,000 cases occurred in Colombia during the outbreaks caused by serotypes 2 and 3, in 1971-1972 and 1977, respectively.

In 1977 a type 1 pandemic began in Jamaica and spread from there clockwise around the Caribbean causing epidemics in almost every island. In late 1977 it reached South America causing epidemics in the Guianas and Venezuela. In 1978 it reached Colombia and Central America. By the end of 1978 the virus crossed the Mexican border where it continued to spread through 1979, and in 1980 it reached Texas where it caused the first autochthonous cases recorded in the United States since 1945. Approximately 550,000 cases were registered in Cuba and an estimate made in Colombia indicated that 770,000 cases occurred. Nevertheless, the countries notified PAHO of only 702,000 dengue cases during 1977-1980.

Two important events were registered in 1981: the introduction of dengue 4 in the Americas and the first outbreak of dengue hemorrhagic fever (DHF) in the Hemisphere. Dengue 4 activity was documented in many islands of the Caribbean during 1981-1982 (PAHO *Epidemiological Bulletin* Vol. 3, No. 5, 1982). Outbreaks were also recorded in Suriname, Brazil, and Colombia in 1982. Both dengue 1 and 4 were isolated in the Brazilian outbreak, which occurred in the town of Boa Vista, northern Brazil; this is the first time that dengue viruses have been isolated in that country. During the Suriname outbreak three males over the age of 45 developed dengue shock syndrome (DSS) without hemorrhagic manifestations but all had thrombocytopenia and hemoconcentration; all three had serologic evidence of unspecified dengue infection and one died a month later from bleeding of esophageal varices. Illness associated with dengue type-4 viral infection has been self-limited and generally mild. Virus activity has been low to moderate, and, in spite of a widening dissemination of the virus, has not caused serious outbreaks in the Hemisphere.

From May to October 1981, Cuba experienced a widespread outbreak of dengue-2 during which 344,203 cases were notified (PAHO *Epidemiological Bulletin* Vol. 3, No. 1, 1982). In addition to the classic benign febrile syndrome, serious hemorrhagic and shock manifestations were also present. A total of 116,143 cases was hospitalized, of which some 10,000 were cases of DHF/DSS. A total of 158 deaths was recorded, one-third of which were among persons over 15 years of age. An intensive *Aedes aegypti* eradication program was initiated soon after the outbreak was identified and, as a result, it was quickly brought under control. No additional dengue cases have been identified in Cuba since the end of 1981.

Yellow Fever

Jungle yellow fever (YF) continues as a major threat in endemic areas of South America. Ten countries reported a total of 1,204 cases of YF in the past decade —Bolivia, Brazil, Colombia, Ecuador, Panama, Paraguay, Peru, Suriname, Trinidad and Tobago, and Venezuela. A 63 per cent increase in the number of reported cases was observed in the second half of the 1970s as compared with those of the first half of the same decade. A total of 489 cases was notified from 1980 to 1982, 80 per cent of which occurred in Bolivia and Peru. Colonists and temporary agriculture workers from nonendemic areas, together with natives from endemic zones engaged in forest activities, were the main target of the disease. The virus is enzootic in tropical forests of South America, such as those of the Amazon region and the Orinoco (Venezuela) and Magdalena (Colombia) valleys. The periodic occurrence of YF outbreaks in central Brazil, at intervals of five to nine years may be due to virus excursions from the Amazon region. Although transovarial transmission of YF virus in *A. aegypti* and in *Haemagogus* has been documented in the laboratory, limited field studies undertaken in the Americas do not yet give support to the occurrence of this phenomenon in nature. Notably, YF virus is able to reappear in areas after being silent for long periods of time. The outbreaks in the Tarra River area and in Sierra Nevada, Colombia, and in Trinidad in 1978-1979 after 19 or more years of silence, demonstrate the potential of resurgence of the virus. Similarly, the 1981 outbreak in the Andrés Ibáñez Province, Department of Santa Cruz, Bolivia, occurred after more than a three-decade absence of the disease. Of special concern was the occurrence in some countries of cases in close proximity to areas infested with *A. aegypti*, and the consequent risk of urbanization of YF. Most cases of YF continue to occur in the first half of the year, peaking in March-April. The great majority of cases in the Americas is in males over the age of 15. Children in the 1-4 age group were affected in the Rincón del Tigre area, eastern Bolivia, in 1981, although in this outbreak most information was collected retrospectively and was based mainly upon clinical grounds.

Oropouche Fever

During the period 1961-1981, at least 250,000 persons were infected by Oropouche virus in the Amazon region of Brazil. Patients usually develop a febrile illness and sometimes aseptic meningitis. A rash is occasionally observed. Although not fatal and free of sequelae, the infection may cause severe manifestations, including one or more episodes of recurrence of symptoms, and may require hospitalization. Some outbreaks are explosive and may cause temporary disruption of community activities. Epidemics occur in urban settings, where the virus is biologically transmitted from man-to-man through the bite of the *Culicoides paraensis* midge. Oropouche virus is the only arbovirus of public health importance that affects man known to be transmitted by *Culicoides*. The mosquito *Culex quinquefasciatus* may act as a secondary vector. Since *Culicoides paraensis* is widely distributed throughout South America, Central America, Mexico, and the eastern United States, Oropouche fever has the potential to spread to some of these areas.

Mayaro Fever

Immunity to Mayaro virus is widely distributed in human populations of rural areas of tropical South America. In some localities up to 60 per cent of the population have demonstrable antibodies to this alfavirus. Nevertheless, only a few outbreaks due to this agent have been described. No fatalities due to Mayaro infection have been reported, but patients may exhibit severe arthralgia, particularly of the extremities, which may cause temporary incapacitation.

Arboviral Encephalitis

Arboviral encephalitis in the Americas is mostly associated with six arboviruses.

St. Louis encephalitis (SLE). Although SLE virus is widely distributed in the Hemisphere, only in North America is the disease recognized as a major public health problem. It is estimated that as many as 10,000 cases of encephalitis and about 1,000 deaths have been recorded since the SLE virus was discovered in 1933. The great majority of them were registered in the United States. The largest epidemic in the history of the disease occurred in 1975, when 1,815 cases were recorded in this country. Outside the United States and Canada, a single outbreak was recorded in Mexico in 1974, when 51 cases were diagnosed. Seven cases with serologic evidence of SLE virus infection were reported from Argentina, Jamaica, Suriname, and Trinidad between 1953 and 1965. The few cases of SLE virus infection confirmed by isolation of the agent in Central and South America have generally been characterized by relatively mild febrile illness. In the continental United States all but six states have reported cases of SLE. Several important urban outbreaks have occurred in some of these states. The incidence of disease in persons over 60 years of age is 5-40 times higher than that in the 0-9 years age group.

California encephalitis (CE). CE is usually associated with La Crosse virus infection. This virus is responsible for 30 to 160 cases annually in the United States. Isolated cases have been reported from Canada. La Crosse virus principally affects children under 12 years of age and has a case fatality rate under 1 per cent. The disease is highly focal in distribution, depending on the presence of hardwood forests with tree holes, one of the main breeding sites of its prime vector, *Aedes triseriatus*. In recent years, however, foci of infection have consistently been located around tire dumps and playgrounds, where the mosquito has been found breeding in tires.

Eastern equine encephalitis (EEE). EEE is a rare but severe disease of man in the Americas. The overall case fatality rate among clinical cases in North America approaches 70 per cent. Outside the United States, one outbreak was recorded in the Dominican Republic in 1948-1949, and one in Jamaica in 1962; two cases were reported from Trinidad and one from Brazil. Several outbreaks have been registered among horses, quails, pheasants, peking ducks, and partridges. Among these exotic birds, attack rates of up to 50 per cent and serious economic losses have been recorded in North America.

Western equine encephalitis (WEE). WEE virus disease in man is basically an exclusive problem of the United States and Canada. A total of 897 cases of WEE were recorded in the United States during the period 1955-1976. The highest incidence was observed in 1965, when 172 cases were recorded. The only case registered in Latin America and the Caribbean was diagnosed on clinical and serologic grounds in Rio de Janeiro, Brazil, in 1961. Epizootics among equines have been documented in the United States. Argentina, Brazil, and Guyana. Flocks of pheasants and partridges have also been stricken by the agent, but the outbreaks are not as devastating as those caused by EEE virus.

Venezuelan equine encephalitis (VEE). VEE virus is endemic in northern South America, Central America, Trinidad, Mexico and Florida. Periodically, it appears as epizootics and epidemics, as observed during 1967-1971, when the virus spread from South America through Central America and into the United States. It is estimated that over 100,000 equine deaths and hundreds of thousands of human infections occurred

during this period. About 1 per cent of infected persons develop clinical encephalitis. The case-fatality rate is usually very low, but may reach 3.6 per 100 in the absence of adequate medical care. Virus activity has been silent in recent years, probably due to intensive horse vaccination control programs.

Rocio encephalitis. Rocio encephalitis is a focal disease which has occurred exclusively in the southern coast of São Paulo State, Brazil. The virus apparently emerged for the first time in 1975 and for two consecutive years caused outbreaks during which about 1,000 clinical cases were diagnosed. The overall case fatality rate among hospitalized patients was about 5 per cent. Approximately 20 per cent of the survivors exhibited significant residual impairment of cerebral functions. Transmission was associated with forest contact and most cases were seen in persons over 15 years of age. No additional clinical cases have been observed since 1976.

Rodent-borne Viral Diseases

Argentine and Bolivian Hemorrhagic fevers are the two rodent-borne viral diseases of public health importance presently recognized in the Americas. Recent evidence indicates that a virus similar to Hantaan virus, the causative agent of hemorrhagic fever with renal syndrome occurs in some parts of the Americas.

Argentine Hemorrhagic Fever (AHF)

Since the early 1950s AHF has been recognized as a major public health problem in certain agricultural areas of Argentina. Over 18,000 cases were reported in that country from 1958 to 1980, with a fatality rate of 10-15 per cent in untreated patients. A gradual increase of the endemic area of AHF has been observed since 1958; it currently encompasses approximately 100,000 km^2 including parts of the Provinces of Buenos Aires, La Pampa, Santa Fe, and Córdoba, and contains over one million inhabitants. The infection occurs almost exclusively among corn and wheat field workers. The disease has a marked seasonal variation, with highest incidence of cases in April, May, and June. A live attenuated candidate vaccine is presently under development and it is hoped that it will be available for protection of persons at risk in the near future.

Bolivian Hemorrhagic Fever (BHF)

The first outbreak of BHF was identified in 1962 and subsequently several others were detected, all in the 1960s. The two main outbreaks occurred in the community of Orobayaya and in the town of San Joaquín, in the Provinces of Iténez and Mamoré, respectively, and the Department of Beni, but hamlets and farms of that Department experienced sizable epidemics. Altogether it is estimated that 2,000 to 3,000 persons were affected by the disease with a case fatality rate of about 20 per cent. A small nosocomial outbreak involving six persons, five of whom died, was reported in Cochabamba in 1971. This town is located outside the endemic region, but apparently the index case contracted the disease in an infected area of Beni. An effective rodent control program against infected *Calomys callosus*, the host of BHF virus, has been undertaken by the Bolivian authorities, and as a result no human cases of BHF have been registered since 1975.

Hemorrhagic Fever with Renal Syndrome (HFRS)

Antibodies to Hantaan virus have been found recently among urban rats collected in some cities of the United States. Unpublished observations indicate that immunity to the same agent exists among human and urban rat populations of the Amazon region of Brazil. Further investigations are underway to identify the agent and to define the disease pattern in these regions.

(*Source:* Epidemiology Unit, Health Programs Development, PAHO.)

Program for Diarrheal Disease Control in Cali, Colombia

In 1975 an acute diarrheal disease control program was initiated at the Siloé Health Center of the Cali Regional Health Unit.[1] Its initial objective was to reduce diarrheal disease mortality to 50 per cent in children under five during the following five-year period. Since that time, the program has been progressively extended to all the health institutions in the Municipality of Cali.

In 1980 the population of Cali was estimated at 1,277,963, with a demographic structure in which 9.7 per cent of the population was under four years of age. As to water supply services, the city has three treatment plants and a 1,363,500-meter water supply network with approximately 96 per cent coverage inside the urban perimeter. Sewerage and sanitation services have a coverage of 90 per cent and 70 per cent, respectively.

Many of the neighborhoods located in the city's outlying areas are made up of squatter settlements, where the population is mostly composed of immigrants who usually have inadequate environmental sanitation. At present, the more recently settled areas have close to 30,000 families living on floodplains below the level of the Cauca River.

The city has two hospitals, four hospital centers, 19 urban health centers, 10 rural health centers, eight urban health posts, and 10 rural health posts. All these establishments provide, among other activities, maternal and child services, environmental sanitation, health education, and epidemiological surveillance, in accordance with their various degrees of complexity.

To ensure the provision of health services, the city has been divided into four program areas, which permits a sufficiently expeditious system for patient referral. Each area is made up of centers and health posts and a reference hospital center. The majority of the patients are served initially at the centers and ambulatory primary care posts. The patients who need more specialized services or hospitalization are sent by ambulance to the respective hospital center.

The program for diarrheal disease control was based on data that made it possible to make a diagnosis of the health situation and its relation to these diseases. These data provided information on the principal demographic and social aspects in the different program areas, the populations from 0 to 11 months and from 1 to 4 years, morbidity and mortality from diarrheal diseases, and the basic sanitary conditions in each area and, at the same time facilitated the identification and location of human, material, institutional, and community resources. The establishment of the goals of the program was supported by that information.

During the initial phase, personnel at different levels received training and a sufficient quantity of oral rehydration salts was provided by the Ministry of Health. During the development of the program there were additional resources from particular entities and active participation by the communities through the so-called Community Action Boards. Also, precise standards were established for the care of children with diarrheal diseases at the services and in the home, in accordance with the different levels of complexity of the institutions utilized. Finally, research was begun on different aspects of the program, placing special emphasis on better knowledge of the etiology of the infectious process and on the importance of socioeconomic factors in morbidity and mortality from enteritis. No statistical form was included, or any new clinical history, since the existing information system permits the epidemiological and operational evaluation of the program. All death certificates in the city of Cali have to be sent, immediately after each death, to the Epidemiology Unit, where they are tabulated and analyzed monthly. The evaluation is done every six months and covers operational and epidemiological aspects, and the possible impact the program may have on mortality.

Mortality from acute diarrheal diseases shows a steady decline in children under one year, and those from 1 to 4 and under 5 years, between 1970 and 1981 (Table 1). For purposes of analyzing mortality, the period was divided in the two stages before and after 1975, the year when oral rehydration therapy was initiated. The general trend of mortality from diarrhea was downward and becomes more drastic after the start of the program.

Mortality in the 1 to 4 age group continues in the same trend observed in children under one year, but with a much lower mortality rate (7 times lower in 1979).

[1]The oral rehydration formula recommended by the World Health Organization was used: sodium chloride (3.5 g), sodium bicarbonate (2.5 g), potassium chloride (1.5 g), and glucose (20.0 g).

Mortality from diarrhea in the four program areas presents a declining trend, although at different rates of speed. Comparing the years 1975 and 1981, it can be noted that the reduction was 56 per cent in area 1, 31 per cent in area 2, 44.7 per cent in area 3, and 30.7 per cent in area 4. Area 1 has the greatest concentration of urban population and, in addition, a larger number of new human settlements inhabited by families of limited economic resources. Many of these squatter settlements have been constructed on the hills of the northern area of the city, where the topographic situation makes it difficult for the Government to provide suitable water supply and sewerage services.

Table 1. Number of deaths from gastroenteritis in children under 1 and 1-4 years of age, with rates per 1,000 population, Cali, Colombia, 1970-1981.

Year	< 5 years				Total	
	< 1 year		1-4 years			
	No. of deaths	Rate	No. of deaths	Rate	No. of deaths	Rate
1970	445	14.9	209	2.4	654	5.6
1971	469	17.1	264	3.1	733	6.4
1972	541	22.3	272	3.1	813	7.3
1973	376	16.9	199	2.3	575	5.2
1974	362	16.4	175	1.9	537	4.8
1975	327	14.8	127	1.3	454	4.0
1976	366	15.2	167	1.7	533	4.6
1977	258	10.9	115	1.1	373	3.2
1978	247	10.3	88	0.8	335	2.8
1979	170	6.8	66	0.7	236	1.9
1980	235	9.0	72	0.8	307	2.6
1981	166	6.3	81	0.8	247	2.0

Table 2 shows the rapid decline in the importance of this group of diseases relative to mortality from all causes, in the under-five age group, especially in those under one year.

The system for the certification and analysis of diarrhea cases is incorporated in the city's general system for epidemiological surveillance of communicable diseases, which only includes the official services already described. It is possible that the progressively rising trend of cases in all ages (Table 3) is the result of improved coverage in case-finding and in the care of diarrhea cases or of the presence of epidemic outbreaks,

Table 2. Ratio of deaths from diarrheal diseases in children under 1 and 1-4 years of age over total deaths in each age group, Cali, Colombia, 1970-1981.

Year	< 5 years		Total (%)
	< 1 year (%)	1-4 years (%)	
1970	32.8	38.1	34.3
1971	30.7	37.4	32.8
1972	35.8	40.5	37.2
1973	29.9	40.7	33.0
1974	28.4	34.4	30.1
1975	26.6	32.8	27.3
1976	26.7	31.5	28.1
1977	22.3	28.8	23.9
1978	25.6	28.9	26.4
1979	22.5	22.0	19.5
1980	26.8	25.7	26.3
1981	21.3	32.7	23.8

Table 3. Number of diarrheal disease cases in children under 1 and 1-4 years of age, with rates per 1,000 population, Cali, Colombia, 1975-1981.

Year	< 5 years				Total	
	< 1 year		1-4 years			
	No. of cases	Rate	No. of cases	Rate	No. of cases	Rate
1975	1,491	67.41	4,965	55.21	6,456	57.61
1976	4,522	188.23	3,719	40.91	8,241	71.71
1977	4,853	205.01	4,324	47.07	9,177	79.43
1978	7,058	293.30	4,180	45.02	11,238	96.12
1979	9,098	366.75	11,443	121.94	20,541	173.12
1980	5,452	209.19	4,809	50.70	16,511[a]	136.56
1981	6,851	258.59	7,087	73.93	13,938	113.92

[a] Includes 6,250 cases in children under 5 years of age, not classified by age group or health area.

as seems to have occurred in 1979. It is interesting to note that, of all the cases reported annually in children under five, except for 1975 and 1978, practically half the cases were registered in those under one year.

The highest morbidity rates reported by each area between 1975 and 1981 are observed in areas 1 and 3. It is

in these areas, precisely, where mortality from diarrhea has declined most dramatically. The elevated number of cases of diarrhea registered in them appears, then, to be due, in part, to improved case-finding and health care coverage of sick patients. Some of the neighborhoods that are in these two areas are populated by families from rural zones which at present lack appropriate water supply and excreta disposal services. In any case, these two areas of the city are the ones of greatest demographic density and the ones which at the same time have greater accessibility to the health services. Early weaning may be a factor contributing toward an increased risk of acute episodes of diarrhea in the earlier ages. Also, it is probable that many of the cases that have been reported are diarrheal episodes noted in the same child in a short space of time and would be part of a single attack of acute diarrhea or, on the contrary, children with successive attacks of acute diarrheal disease that are reported a single time as continuous cases.

The data presented illustrate the need to perfom an initial diagnosis of the situation and to formulate and carry out diarrheal diseases control programs that are integrated with the rest of the health programs, especially the maternal and child area. In addition, it is necessary to have a simple and effective surveillance system incorporated into the rest of the information services, which will make it possible to evaluate and measure the effect caused by the programs for oral rehydration in the reduction of mortality from diarrhea.

(*Source*: Dr. Melba de Borrero, Director, National Diarrheal Disease Control Program, Ministry of Health, Colombia and Epidemiology Unit, Health Programs Development, PAHO.)

Diseases Subject to the International Health Regulations

Cholera, yellow fever, and plague cases and deaths reported in the Region of the Americas up to 30 June 1983.

Country and administrative subdivision	Cholera cases	Yellow fever		Plague
		Cases	Deaths	Cases
BOLIVIA	—	*11*	*10*	*20*
Beni	—	1	1	—
Cochabamba	—	8	7	—
La Paz	—	2	2	20
BRAZIL	—	*3*	*3*	—
Rondônia	—	2	2	—
Pará	—	1	1	—
COLOMBIA	—	*1*	*1*	—
Santander	—	1[a]	1[a]	—
ECUADOR	—	3	—	*64*
Chimborazo	—	—	—	64
Pastaza	—	3	—	—
PERU	—	*18*	*17*	—
Huanuco	—	1	1	—
Junin	—	3	3	—
Madre de Dios	—	4	4	—
San Martín	—	10	9	—
UNITED STATES	—	—	—	*16*
Arizona	—	—	—	7
New Mexico	—	—	—	7
Oregon	—	—	—	1
Utah	—	—	—	1

[a]Imported.

The Tuberculosis Situation in Argentina

For the purposes of conducting an epidemiological analysis of the tuberculosis situation, the National Institute of Tuberculosis (INT) of Argentina divided the country into six regions: North, at the border of Chile and Bolivia; Northeast, at the border of Paraguay and Brazil; Patagonian South; Central, Buenos Aires Province; Temperate Pampa; and Greater Buenos Aires, which includes the Federal Capital and its metropolitan communities representing more than a third of the country's population.[1]

In 1974 a national study on risk of infection (individual inhabitant's probability of being infected or reinfected with tuberculosis in the course of a year) was begun with a prevalence study carried out on samples of schoolchildren from the city of Santa Fe, the Province of Santa Fe, and the six areas into which the country is divided. Five years later the risk study was completed, as was a second prevalence study carried out in the Province of Santa Fe. The data obtained made it possible to observe an annual risk of infection of 0.26 per cent, with a 4.6 per cent declining trend (1979-1980) in this province. The risk for the country was calculated at 0.5 per cent, with an estimated annual reduction trend of 5 per cent. Based on these results, the annual incidence was estimated at 25 to 30 bacilli-positive cases per 100,000 population.[2]

The data obtained from case reports yield a similar country rate (30 bacilli-positive cases per 100,000 population), although 100 per cent efficiency cannot be assumed for case-finding, bacilloscopic confirmation, or new case reporting. The incidence of bacilli-positive cases, calculated on the basis of estimated risk of infection (1 per cent) was 60 per 100,000 population in the northern and southern areas of the country, whereas reported cases were double that figure. The estimated incidence rate was higher than or equal to the reported rate in other areas. It is worth noting that 80 per cent of the country's 28 million inhabitants live in urban areas.

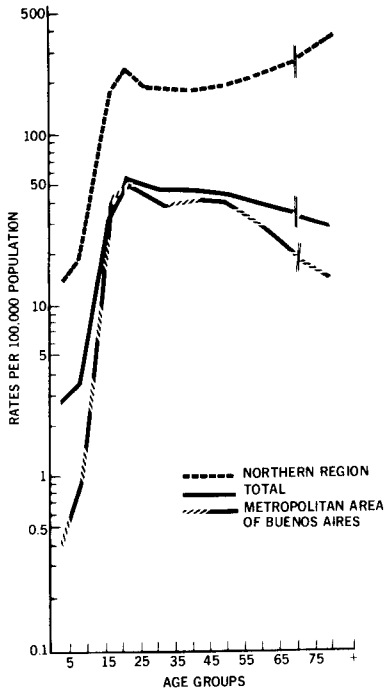
A possible explanation for the great difference between the estimated and reported incidence is that the selected population of 6-7 year-olds in the first grade in school excludes the less advantaged children, among whom the prevalence of infection is presumably greater. Although education is free and compulsory and practically the entire cohort attends the first grade, it is possible that a large number of children in this socioeconomic group start school at an older age than the selected group. If this is the cause of the underestimated incidence, it would fundamentally affect the less developed areas (north and south). The estimation of risk trend would not be altered because both prevalence surveys would be affected by the same error factor.

Ten years after implementing the system for analyzing data reported to the National Institute of Tuberculosis (INT), reporting is thought to have reached a sufficiently high level of coverage that it begins to acquire value as an epidemiological indicator. It is evident that there are bound to be increases owing to greater coverage and diagnosis (especially in children), but these should not be sufficient to mask the actual reduction in incidence.

Table 1 shows the age distribution of total pulmonary tuberculosis cases confirmed by bacteriology and by direct examination of sputum for the entire country in 1980.

No reduction has been observed in the incidence of bacilli-positive cases during the past decade, even in the 15 to 29 age group where the effect of the program

Figure 1. Reported bacilliferous tuberculosis incidence rates per 100,000 population, by age group, Argentina, 1980.



SOURCE : NATIONAL TUBERCULOSIS INSTITUTE/MINISTRY OF PUBLIC HEALTH AND ENVIRONMENT, ARGENTINA.

[1]For more information please contact: Instituto Nacional de Tuberculosis, Casilla de Correo 106, 3000 Santa Fe, Argentina.

[2]Styblo, K. and A. Rouillon. *Bull Int Union Tuberc* 56(3/4): 128-137, 1981.

should be more easily appreciated. This could be due to the gradual extension of diagnostic coverage and reporting. In addition, the intense migration, especially of young adults, from areas of high prevalence toward the more developed urban centers obscures the reduction in the stable resident population in the analysis by province.

When the age-specific incidence rates of the entire country are compared with those of the metropolitan area of Buenos Aires and the northern region, large variations are observed which correspond to socioeconomic differences in said regions (Figure 1). The metropolitan area, with its 9,697,000 inhabitants and incidence rate of bacilli-positive cases of 29.4, and the northern region, with 977,000 inhabitants and a rate of 132.3, constitute the two extremes in incidence rates when considering the six regions into which the country is divided for the purpose of evaluating the tuberculosis problem. Since the areas where the problem is greater—north, northeast, and south—have a small proportion of the total population, they have little influence on the national average and on its variations.

The group under 15 years of age, where the program's activities are most effective, represents only 28.5 per cent of the total population due to the reduced natural increase (16.4 x 1,000). When this is coupled with a life expectancy of 69.4 years which is also on the rise (1975-1980), the impact of the program may be limited due to the survival of a large number of elderly infected adults who continue to produce open cases of endogenous tuberculosis.[3]

Because of the reduced number of deaths, the analysis of tuberculosis mortality is carried out only every two years. In the last 12 years, mortality has decreased steadily at a rate of 5.8 per cent per year. In 1979-1980, the rate for the country was 6.2 per 100,000 population, 8.2 in males and 4.3 in females, ranging from 3.3 in the metropolitan area of Buenos Aires to 22.4 in the northern region.

It is interesting to compare the 1973-1974 and 1979-1980 age-specific death rates. The largest reduction in mortality occurs in the 5-14 age group, possibly due to the direct effect of BCG vaccination, which has wide coverage in the school age group and still very low coverage in the group under 5, and the reduction in transmission. This hypothesis would be strengthened if the increase in BCG coverage in the 0-4 age group were to produce a similar decrease in the death rates for that group in the coming years.

[3]Waaler, H.T. *Bull Int Union Tuber* 57(34): 202-205, 1982.

Table 1. Tuberculosis cases reported to the National Tuberculosis Institute and rates per 100,000 population, Argentina, 1980.[a]

Age	Tuberculosis, all forms		Pulmonary tuberculosis		Pulmonary tuberculosis bacteriologically confirmed		Pulmonary tuberculosis with direct, positive examination	
	Cases	Rate	Cases	Rate	Cases	Rate	Cases	Rate
0 - 4	1,582	61.9	440	17.2	73	2.9	67	2.6
5 - 9	994	41.4	342	14.2	85	3.5	75	3.1
10-14	722	32.4	392	17.6	197	8.8	184	8.3
15-19	1,334	61.7	1,121	51.8	829	38.3	776	35.9
20-24	1,741	82.6	1,490	70.7	1,135	53.8	1,086	51.5
25-29	1,536	75.9	1,302	64.3	983	48.6	940	46.4
30-34	1,317	71.9	1,112	60.7	841	45.9	788	43.0
35-44	2,205	71.5	1,872	60.7	1,432	46.4	1,339	43.4
45-54	1,969	68.0	1,747	60.4	1,287	44.5	1,192	41.2
55-64	1,406	61.4	1,253	54.7	909	39.7	847	37.0
65-74	830	55.4	726	48.5	492	32.8	455	30.4
75	376	49.7	338	44.6	215	28.4	194	25.6
N/S[b]	394	—	314	—	218	—	211	—
Total	16,406	63.5	12,449	48.2	8,696	33.7	8,154	31.6

[a] Adapted from tuberculosis case reports National Tuberculosis Institute, Argentina, 1979-1980.

[b] Not specified.

The INT carries out training, epidemiological surveillance, and technical support activities for the national and provincial programs. The provinces send out a monthly report of new cases on standard forms which contain basic information. In addition to permitting analysis by province, age, sex, site of lesion and bacteriology, treatment background, etc., these forms make it possible to obtain samples from patients for the purpose of perfoming periodic evaluations of the operative results of treatment.

In 1982 an analysis was made of the information available on the epidemiological situation and on the program for each province. The selected epidemiological indicators were mortality, morbidity (incidence), infection, and meningitis in children 0-4 years old. The tables and graphs for each indicator were analyzed in terms of quality of the information and in relation to what is expected of an effective control program. The document was completed with a practical evaluation task carried out as a self-instruction exercise by those responsible for the program in each province.

This type of exercise supplements the training received by program administrators during the annual course offered by the INT and other international courses, through applying the data to the special conditions of the program for which they are responsible, thus constituting continuing education, indirect supervision, and evaluation. The method could be utilized for regional evaluation of programs in other countries and for the evaluation of national programs, with the necessary adjustment to the different systems for registering information.

(*Source*: Tuberculosis and Acute Respiratory Diseases Program, Maternal and Child Health Program, PAHO.)

Infections due to Penicillinase-producing *Neisseria gonorrhoeae* in Florida, United States

From 1 January through 31 December 1981, a total of 436 infections due to penicillinase-producing *Neisseria gonorrhoeae* (PPNG) were reported in Florida—a marked increase over the number of cases in previous years. Only three cases were reported from 1976 through 1979, and 15 cases were reported in 1980. The increase in reported cases in 1981 was temporally related to a change in laboratory surveillance for PPNG strains. In mid-December 1980, all gonococcal isolates in cultures submitted to State branch laboratories were tested for beta-lactamase production, in contrast to the previous policy which limited testing to post-treatment isolates from patients not cured by their initial therapy. A total of 914 PPNG cases were reported in 1982, an increase of 110 per cent over the 436 cases reported in 1981. The epidemic has continued through the first quarter of 1983.

Most cases reported in Florida have been among residents of South Florida, especially the Miami-Dade County area. Dade County, with a population of 1.8 million (17 per cent of the State population) accounted for more than 60 per cent of the 1981 cases and more than half of the cases reported in Florida during 1982 (Table 1). Attempts at control were first made during

Table 1. Reported cases of penicillinase-producing *Neisseria gonorrhoeae* (PPNG) in Florida State and Dade County, 1979-1983.

Year	Florida State	Dade County	
	Number	Number	Percentage
1979	—	—	—
1980	15	10	67
1981	436	281	64
1982	914	466	51
1983[a]	—	389	54

[a]January through March 1983.

May 1981, when it became clear that an epidemic was occurring. Cultures were obtained from all men with positive smears for gonorrhea and the isolates were tested for beta-lactamase production. The practice in the Dade County sexually transmitted diseases (STD) clinic until then was to diagnose and treat men with urethritis on the basis of the findings on a gram-stained smear, without testing for gonococci. Control, however, was not achieved, and reported cases of PPNG infection continued unabated. The next attempt at control was in July 1981. A team was developed with the aim of centralizing and organizing the control approach. Also, efforts at tracing sexual contacts were intensified. In November (four months later) it appeared that control had been achieved, since only 16 cases were reported that month, compared to 61 cases in August 1981. The November low was short-lived, however, and the epidemic continued through 1982, with wide fluctuations in the number of cases reported monthly. After the August peak of 59 cases and the concern that a wave of migrants soon to arrive in the area would fuel the epidemic, an intensive intervention program was adopted in cooperation with the Centers for Disease Control (CDC), Atlanta, Georgia. Intervention methods included the widespread use of spectinomycin or cefotaxime[1] in target areas as the initial antibiotic treatment for patients and contacts with gonococcal or presumed gonococcal infection. This policy was adopted not only in Dade County, but in neighboring regions reporting high PPNG morbidity, such as the Belle Glade, Palm Beach, and Fort Myers areas.

Additional measures included intensification of the ongoing control program, specifically to ensure that cultures were obtained from all men with positive urethral smears, all women undergoing pelvic examinations, and all known and suspected contacts of patients with gonorrhea. Patients with PPNG infections were interviewed promptly and in detail, and identified contacts were treated prophylactically with either spectinomycin or cefotaxime. A publicity campaign was mounted to alert private physicians to the problem especially in Dade County, and commercial laboratories were contacted and urged to perform beta-lactamase testing on all gonococcal isolates. In addition, several press and radio news releases alerted the public to the problem.

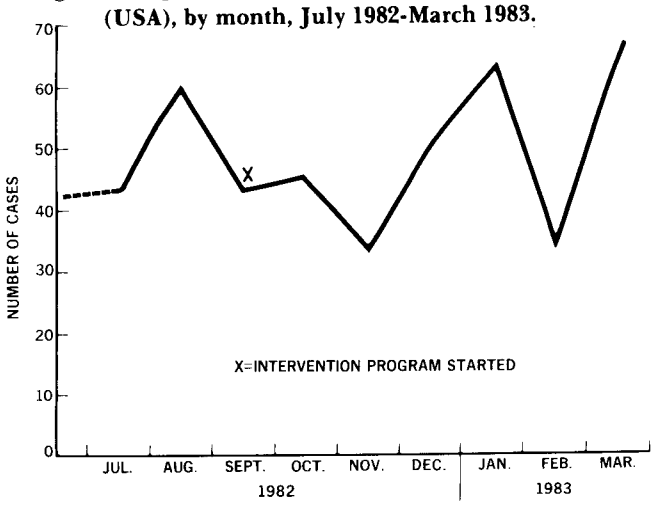
The results of the intervention measures were less dramatic than had been anticipated. Reported PPNG cases in Dade County, although declining initially, increased in December 1982 and January 1983, surpassing reported cases in each of the two preceding months (Figure 1).

A total of 466 PPNG cases was reported in Dade County during 1982, representing an increase of 66 per cent over the 281 cases reported in 1981. This trend is similar to that observed nationally, where reported cases continue to increase steadily. The 466 PPNG cases account for 5 per cent of all gonococcal isolates identified in Dade County during 1982. Of the 466 cases, 160 were women, making the ratio of females to males approximately 1:2. This ratio contrasts with the 1:1 ratio observed in the pre-epidemic period early in 1981. Twelve of the 160 women with PPNG admitted to prostitution or were suspected to be prostitutes. Five cases were reported among homosexual men. Except for one chain of infection (10 cases) among a white upper middle-class group of professionals who used drugs recreationaly, most cases have been unrelated epidemiologically and have been among blacks living in the inner city area of Miami. Ages of cases ranged from 2 to 71 years, with a median age of 25. Morbidity was highest among the 20-24 age group, which accounted for one-third of the reported PPNG cases.

Several individuals were visiting Miami when they acquired their infections. In one case, a male patient was found to be infected with PPNG when his cultures were tested several days after inadequate treatment with ampicillin and probenecid. The patient did not return for a follow-up test, and field investigations revealed that he had returned to his home in Honduras. Only one case was reported among military personnel. The average time period from initial clinic visit to appropriate antibiotic therapy was 3.3 days; 31 per cent of all PPNG cases were identified through sexual contact tracing.

Failure to control the epidemic in Dade Country may be related to the inability to identify a core group of persons such as prostitutes or asymptomatic carriers.

Figure 1. Reported PPNG cases, Dade County, Florida (USA), by month, July 1982-March 1983.



[1]CDC recommends that patients with PPNG infections and their sexual partners be treated with spectinomycin, 2 g intramuscularly in a single injection with probenecid, 1 g by mouth; or cefotaxime, 1 g, intramuscularly, in a single injection without probenecid.

Prostitutes have played a major role in PPNG epidemics in Los Angeles and New York City, and innovative measures were often necessary to identify such persons. The lack of organized groups of prostitutes in Dade County makes identification even more difficult. Other factors have yet to be clarified, such as the role of gonococcal plasmids in maintaining the epidemic.

(*Source*: Wayne L. Greaves, M.D. and Phillip W. Strine. Centers for Disease Control, Center for Prevention Services, Division of Venereal Disease Control, Atlanta, Georgia, USA.)

Editorial Comment

Penicillinase-producing *N. gonorrhoeae* (PPNG) have been isolated in Argentina, Canada, Chile, Colombia, Costa Rica, Mexico, Panama, Suriname, Trinidad and Tobago, and the United States. Epidemiological evidence obtained from interviews of infected patients suggests that PPNG are also present in Grenada and Saint Lucia. To this growing list we can now add El Salvador, Grand Cayman Island, Grand Turk Island, and Honduras. Clearly PPNG are rapidly becoming well established in Caribbean and Latin American countries.

The outbreak in Miami and the special case who almost certainly returned to Honduras with inadequately treated PPNG illustrate the potential for rapid spread of PPNG to other countries.

PPNG pose a serious threat to gonorrhea control efforts. The loss of penicillin as an inexpensive, effective first drug for treatment of urethritis, results in a significant increase in treatment costs. Extensive use of second- and third-line drugs may be beyond the resources of most sexually transmitted disease control programs.

It is imperative that small pilot surveillance projects such as the Inter-American Collaborative Study of Antibiotic Susceptibility of *N. gonorrhoeae* (financed by the International Development Research Center of Canada in Argentina, Brazil, Chile, and Jamaica) be initiated to determine the presence and extent of PPNG. Ongoing or periodic monitoring of the frequency with which PPNG are isolated may assist indirectly in determining the efficacy of penicillin treatment regimens.

Development of a Leprosy Vaccine

Among the objectives of the ongoing research programs in leprosy immunology throughout the world is the development of a vaccine against the disease. In the Region of the Americas, the Pan American Center for Research and Training in Leprosy and Tropical Diseases (CEPIALET) in Caracas, Venezuela has been working on a vaccine for the prevention and cure of leprosy. The Director of CEPIALET, Dr. Jacinto Convit, recently described some of the findings of this work in a lecture given at the VI Public Health Congress held in Barquisimeto, Lara State, Venezuela. What follows is a summary of that presentation.

A specific immunologic defect for *Mycobacterium leprae* has been demonstrated in leprosy patients and in healthy persons who live in areas where leprosy is endemic. This immunologic defect can be found in healthy persons with persistently negative response to lepromin (Mitsuda reaction), in patients with the indeterminate form of leprosy who show a negative response to the Mitsuda test, and especially in the lepromatous form or in that part of the spectrum that is closest to being so.

Most of the population is highly resistant to leprosy in any of its forms; one can assume, therefore, that even patients with tuberculoid forms of the disease and those in the area of the spectrum closest to these forms, also have a partial immunologic defect.

The specificity of the immunologic defect was demonstrated several years ago with different species of *Mycobacterium*. The forms of low resistance to the disease respond to *M. leprae* by producing an undifferentiated macrophagic "incompetent" granuloma with numerous intracellular microorganisms. On the contrary, the behavior of these forms of the disease to BCG results in the production of an immune granuloma made up of epithelioid cells and giant cells with lymphoid cell infiltrate where intracellular microorganisms are not found.

A simple explanation used to interpret the immune defect is that it could constitute a macrophagic defect in the presentation of the antigen to the lymphoid cells necessary for development of the phenomena of cell-mediated immunity. This defect can be observed in the cell's inability to digest the bacilli. In these individuals, tests in vivo and in vitro do not show sensitized lymphoid cells.

Other possible explanations of the phenomenon could be absence of the recognition factor for the spe-

cific antigen that depends on the lymphoid system or the development of suppressive cells. When persons not sensitized to BCG and incapable of discarding *M. leprae* from their tissues are injected with a mixture of BCG + *M. leprae*, both microorganisms are eliminated from the site of the injection after two weeks. This may be due to the fact that macrophages have a specific defect for initiating the cell-mediated immunity mechanism that can be overcome by the activation produced by another *Mycobacterium* for which there is no immunologic defect.

The mechanism initiated by the second *Mycobacterium* implies that the development of cell-mediated immunity includes two elements: one that depends on the macrophage and can be induced nonspecifically, and another that depends on the lymphocyte and is specific.

The postulation of a specific macrophagic defect as a mechanism for the development of leprosy is apparently the first example of this type of disorder, but a similar mechanism could be invoked in diseases induced by intracellular parasites, especially when these parasites have a complex cell wall.

Two observations have been decisive in the work of developing a leprosy vaccine at CEPIALET: 1) the local response to the combination of killed *M. leprae* + viable BCG which served as a model in efforts to induce a systemic cell-mediated type of immune response; 2) experience has demonstrated that separate applications of BCG or *M. leprae* are not effective in inducing cell-mediated immunity responses to *M. leprae* in healthy or in sick persons who have a persistently negative Mitsuda. Results obtained in experimental animals (mice and guinea pigs) cannot be extrapolated to man because these animal models do not present the specific immunologic defect that has been demonstrated in man.

The combination of *M. leprae* (killed with heat and purified by the Draper method) with viable BCG has been used in studies in Venezuela as a vaccine for contacts and as immunotherapy in patients who present clinical disease.

The Mitsuda-negative contacts experienced a complete immunologic change eight weeks after vaccination. Patients with indeterminate leprosy and negative Mitsuda (potentially lepromatous) needed more than one vaccination, and, to date, of the 45 patients, 43 presented favorable immunologic changes, the remaining two being under observation.

Repeated vaccinations (from 4 to 6 times) have induced favorable clinical and histopathological modifications in the serious forms of the disease [lepromatous (LL) and borderline lepromatous (BL)] where an appreciable number of cases presented immunologic changes as well as a significant reduction in bacterial population.

The secondary effects of the vaccination have been very limited, and the few observed cases with neuritis and reactions have been easily controlled with thalidomide and dexamethasone.

Clinical, anatomopathologic, bacteriologic, and immunologic results observed both in contacts and in the low resistance forms of the disease support the idea that vaccine therapy will take a prominent place in leprosy treatment. In areas where leprosy is endemic, the vaccine would be administered as a preventive measure to the group at high risk of contracting and developing the disease, such as domiciliary and extradomiciliary contacts.

(*Source*: *Epidemiological Bulletin* No. 3, 1983, Ministry of Health and Social Welfare, Office of Public Health, Venezuela.)

The Health Field Concept — A Canadian Perspective

A basic problem in analyzing the health field has been the absence of an agreed conceptual framework for subdividing it into its principal elements. Without such a framework, it has been difficult to communicate properly or to break up the field into manageable segments which are amenable to analysis and evaluation. It was felt keenly that there was a need to organize the thousands of pieces into an orderly pattern that was both intellectually acceptable and sufficiently simple to permit a quick location, in the pattern, of almost any idea, problem or activity related to health: a sort of map of the health territory.

Such a health field concept envisages that the health field can be broken up into four broad elements: *human biology, environment, lifestyle,* and *health care organization*. These four elements were identified through an examination of the causes and underlying factors of sickness and death in Canada, and from an assessment

of the parts the elements play in affecting the level of health in Canada.

Human Biology

The *human biology* element includes all those aspects of health, both physical and mental, which are developed within the human body as a consequence of the basic biology of man and the organic makeup of the individual. This element includes the genetic inheritance of the individual, the processes of maturation and aging, and the many complex internal systems in the body, such as skeletal, nervous, muscular, cardiovascular, endocrine, digestive and so on. The human body being such a complicated organism, the health implications of human biology are numerous, varied, and serious, and the things that can go wrong with it are legion. This element contributes to all kinds of ill health and mortality, including many chronic diseases (such as arthritis, diabetes, atherosclerosis, cancer), and others (genetic disorders, congenital malformation, mental retardation). Health problems originating from human biology are causing untold miseries and costing billions of dollars in treatment services.

Environment

The *environment* category includes all those matters related to health which are external to the human body and over which the individual has little or no control. Individuals cannot, by themselves, ensure that foods, drugs, cosmetics, devices, water supply, etc. are safe and uncontaminated; that the health hazards of air, water, and noise pollution are controlled; that the spread of communicable diseases is prevented; that effective garbage and sewage disposal is carried out; and that the social environment, including the rapid changes in it, do not have harmful effects on health.

Lifestyle

The *lifestyle* category in the health field concept consists of the aggregation of decisions by individuals which affect their health and over which they more or less have control. Personal decisions and habits that are bad, from a health point of view, create self-imposed risks. When those risks result in illness or death, the victim's lifestyle can be said to have contributed to, or caused, his own illness or death.

Health Care Organization

The fourth category in the concept is *health care organization* which consists of the quantity, quality, arrangement, nature, and relationships of people and resources in the provision of health care. It includes medical practice, nursing, hospitals, nursing homes, medical drugs, public and community health care services, ambulances, dental treatment, and other health services such as optometry, chiropractics, and podiatry. This fourth element is what is generally defined as the health care system.

Until now most of society's efforts to improve health, and the bulk of direct health expenditures, have been focused on the health care organization. Yet, when we identify the present main causes of sickness and death in Canada, we find that they are rooted in the other three elements of the concept: human biology, environment, and lifestyle. It is apparent, therefore, that vast sums are being spent treating diseases that could have been prevented in the first place. Greater attention to the first three conceptual elements is needed if we are to continue to reduce disability and early death.

Characteristics of the Health Field Concept

The *health field concept* has many characteristics which make it a powerful tool for analyzing health problems, determining the health needs of Canadians and choosing the means by which those needs can be met.

One of the evident consequences of the health field concept has been to raise human biology, environment, and lifestyle to a level of categorical importance equal to that of health care organization. This, in itself, is a radical step in view of the clear preeminence that health care organization has had in past concepts of the health field.

A second attribute of the concept is that it is comprehensive. Any health problem can be traced to one, or a combination of the four elements. This comprehensiveness is important because it ensures that all aspects of health will be given due consideration and that all who contribute to health, individually and collectively, patient, physician, scientist, and government, are aware of their roles and their influence on the level of health.

A third feature is that the concept permits a system of analysis by which any question can be examined under the four elements in order to assess their relative significance and interaction. For example, the underlying causes of death from traffic accidents can be found to be due mainly to risks taken by individuals, with lesser importance given to the design of cars and roads, and to the availability of emergency treatment; human biology has little or no significance in this area. In order of importance, therefore, lifestyle, environment, and health care organization contribute to traffic deaths in the proportions of something like 75 per cent, 20 per cent, and 5 per cent, respectively. This analysis permits program planners to focus their attention on the most important contributing factors. Similar assessments of the relative importance of contributing factors can be made for many other health problems.

A fourth feature of the concept is that it permits a further subdivision of factors. Again for traffic deaths in the lifestyle category, the risks taken by individuals can be classed under impaired driving, carelessness, failure to wear seat belts, and speeding. In many ways the concept thus provides a road map which shows the most direct links between health problems, and their underlying causes, and the relative importance of various contributing factors.

Finally, the health field concept provides a new perspective on health, a perspective which frees creative minds for the recognition and exploration of hitherto neglected fields. The importance to their own health of the behavior and habits of individual Canadians is an example of the kind of conclusion that is obtainable by using the health field concept as an analytical tool.

One of the main problems in improving the health of Canadians is that the essential power to do so is widely dispersed among individual citizens, governments, health professions, and institutions. This fragmentation of responsibility has sometimes led to imbalanced approaches, with each participant in the health field pursuing solutions only within his area of interest. Under the health field concept, the fragments are brought together into a unified whole which permits everyone to see the importance of all factors, including those which are the responsibility of others.

This unified view of the health field may well turn out to be one of the concept's main contributions to progress in improving the level of health.

(*Source*: Reprinted from: Marc Lalonde. "A New Perspective on the Health of Canadians: a Working Document." Ottawa, Canada, Information Canada, 1975.)

Editorial Comment

The health field concept has been developed in Canada as a framework for analyzing health problems and as a method for adjusting health policies toward the achievement of health for all by the year 2000. The preceding article has been selected for publication because it represents one of the new and controversial approaches to the use of epidemiology in the solution of health problems and because the dissemination of these approaches constitutes one of the central objectives of the PAHO *Epidemiological Bulletin*.

WHO Collaborating Centers for Viral Diseases

The development of a network of collaborating centers for reference and research on viruses began in 1947 with the establishment of a World Influenza Center in London by the Interim Commission of WHO to carry out worldwide surveillance of influenza. A second Center was soon created for the Americas (Centers for Disease Control, CDC, Atlanta, Georgia, USA). At present, institutions from national influenza centers are linked with the two collaborating centers through WHO. The Centers in Atlanta have agreed to:

- obtain, fully characterize, and preserve representative strains from outbreaks in different parts of the world and distribute them to research and vaccine production laboratories;
- advise on the strains which should be included in influenza vaccines;
- arrange for the training of research workers in specialized techniques;
- collect and distribute, in coordination with PAHO and WHO, epidemiological information about the occurrence of influenza in different parts of the world; and
- provide reagent kits for the national influenza centers.

The problems raised by large poliomyelitis epidemics, together with the development of an inactivated poliovirus vaccine (IPV) in the early 1950s and the need to identify properly many strains of coxsackie and echoviruses isolated in that decade, led to a series of collaborative studies under the aegis of WHO and to the creation of a network of WHO reference centers in 1953. In 1958 this scheme was extended to all other viruses of public health importance. In 1973 the distinction between centers dealing with enteroviruses and respiratory viruses was abolished since many of the centers were in fact working in both fields. Recent advances in certain fields such as hepatitis and special pathogens have led to the addition of new centers to cover these subjects. At present there are in the Region 18 collaborating centers in four countries: 14 in the United States, two in Brazil, and one each in Canada and Jamaica (Table 1). For practical reasons, a distinction has been maintained for influenza, viral hepatitis, mycoplasma, arboviruses, special pathogens, rickettsiae, and those centers which have a specific task rather than a wide range of reference activities.

Table 1. WHO collaborating centers for viral diseases in the Americas.

Area of activity	Institution	Location
For reference and research on influenza	Centers for Disease Control	Atlanta, Georgia, USA
For virus reference and reseach	Centers for Disease Control	Atlanta, Georgia, USA
	National Institute of Allergy and Infectious Diseases	Bethesda, Maryland, USA
	Baylor College of Medicine	Houston, Texas, USA
	Adolfo Lutz Institute	São Paulo, Brazil
	Laboratory Center for Disease Control	Ottawa, Canada
	University of the West Indies	Kingston, Jamaica
For reference and research on viral hepatitis	Centers for Disease Control	Phoenix, Arizona, USA
For mycoplasma reference and research	National Institute of Allergy and Infectious Diseases	Bethesda, Maryland, USA
For arbovirus reference and research	Centers for Disease Control	Fort Collins, Colorado, USA
	Yale University	New Haven, Connecticut, USA
	Evandro Chagas Institute	Belém, Brazil
For virus reference and research of special pathogens	Centers for Disease Control	Atlanta, Georgia, USA
For cell cultures	American Type Culture Collection	Rockville, Maryland, USA
For rickettsial reference and research	University of Maryland	Baltimore, Maryland, USA
	National Institute of Allergy and Infectious Diseases	Hamilton, Montana, USA
	Centers for Disease Control	Atlanta, Georgia, USA

The terms of reference of the viral diseases collaborating centers are: to provide reference services (identification of rare strains); prepare and distribute to national laboratories reference sera, antigens, and strains; take part in collaborative studies; cooperate with national laboratories and provide them with advice and training; give on request advice to governments and assistance in epidemics; collect epidemiological information; and carry out applied research.

(*Source*: Epidemiology Unit, Health Programs Development and Research Coordination, PAHO.)

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