# Epidemiological Bulletin

Pan American Health Organization:
Celebrating 100 Years of Health

**Vol. 23, No. 3** **September 2002**


## Demographic and Mortality Trends in the Region of the Americas, 1980-2000

This year, the Pan American Health Organization (PAHO) celebrates a century of work towards coordinating efforts of the countries to improve health in the most vulnerable populations of the Americas. In carrying out this effort, one of the essential functions of the Organization during this period has been the collection, analysis, and dissemination of information on health among the Member States. As part of its constitutional mandates, PAHO prepares since 1954 a quadrennial report on the health situation and trends in the Americas. Since 1998, this report is published under the title of "Health in the Americas."[1] Its 2002 edition was presented in the previous issue of this Bulletin. This publication contains PAHO's analysis of different public health aspects of the population and the organized responses of the health sector. It accounts for the advances in the health conditions of the countries, and documents existing inequalities in the state of health and the access and use of health resources.

Beginning with this issue, a series of articles will be published in the Bulletin, presenting a summary of the most relevant aspects of the health situation contained in "Health in the Americas." The present article summarizes the situation and trends of the demographic changes, life expectancy at birth, and mortality in the Americas in recent years.

### Introduction

"Demographic transition" in a population refers to a process involving the trends of mortality and fertility rates over time.[2] As mortality starts to decline and social and economic development occur, fertility is expected to drop. In the last decades, reductions in the overall mortality and fertility rates and population growth have been observed in the Americas, intensifying the on-going demographic transition. The consequent aging of the population in the presence of other important socio-demographic processes, such as migration and urbanization, has generated specific and complex demands for social and health goods and services. In addition, the majority of countries in the Americas have experienced what has been called "epidemiological polarization."[3] This process is characterized by simultaneous and substantial impacts on the population's mortality profile by both communicable and non-communicable diseases and external causes. It is especially evident in the more susceptible population groups such as the poor or elderly. The resulting pattern of mortality magnifies the presence of significant health gaps between different social groups and geographic areas within countries.[4] Considering the complex dynamics of the Region's demographic and health conditions in the Region, the aim of the present article is to describe important markers of the "demographic transition" process within the Americas, singling out the changes in relevant indicators in recent years.

DATA SOURCES: This analysis is based on PAHO's core health data, using countries from the American Region as geographic units. The countries were grouped into eight sub-regions including North America, Mexico, Brazil, the Latin Caribbean, Central America, the Andean Area, the Southern Cone and the non-Latin Caribbean.[4] Demographic data come from the United Nations Population Division[5, 6] and the US Census Bureau's International Program Center[7]. Mortality data come from PAHO/WHO's regional database on mortality. The data analysis includes the 19 countries for which data is available for 1980-2000. These countries account for 91.3% of the entire population of the Americas in 2001 and include Argentina, Barbados, Brazil, Canada, Chile, Colombia, Costa Rica, Cuba, the Dominican Republic, Ecuador, El Salvador, Jamaica, Mexico, Panama, Paraguay, Puerto Rico, Trinidad and Tobago, the United Sates, and Venezuela. Mortality rates were standardized by age and sex using the standard population proposed by the World Health Organization.[8, 9]

### Demographic Situation

POPULATION GROWTH: The estimated population in the Americas in 2002 was 854 million (Table 1). The annual average population growth rate in the Region in 1996-2002 was 1.3%, with variations between 0.7% in the non-Latin Caribbean and 2.4% in Central America. In almost all the countries the rate is declining slowly. However, projections indicate that the population of the Americas will continue to grow and some 200 million people will be added between 2000 and 2020.

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URBANIZATION: The population of the Americas is relatively highly urbanized, particularly in the more industrialized countries (Table 1). In 2002, it was estimated that 76.6% of the Region's population lived in cities, compared to 41% in 1950. It should be noted, however, that currently the process of urbanization is occurring more rapidly in the less industrialized countries. The difference between the growth rate of the urban and the rural populations among the subregions was highest in Brazil with 3.4%, followed by the Andean Area with 2.3% and Latin Caribbean with 2.2%, indicating a faster urbanization process there than in other subregions. Approximately half of the largest cities in the Americas are in Latin America. Some 160 million people live in the 20 largest cities, 55 million of them in the largest metropolitan areas of Mexico City, Sao Paulo and New York.

BIRTH AND FERTILITY: There were an estimated 15.7 million births in the Americas in 2002, about 74% from Latin America and the Caribbean (Table 1). Birth rates are expected to continue declining in the Region, as has already occurred over the past 40 years. In the 1960s, the birth rate in the Americas was 32.5 per 1,000 population, while in 2002 it was estimated to be 18.4 per 1,000. Similarly, a reduction in the fertility rates was also observed, with a decline from 3.1 children per woman in 1980-1985 to 2.3 in 2002. In this period, total fertility rates declined in all sub-regions, but more markedly in Brazil, Central America, the Andean Area and Mexico.

AGING AND LIFE EXPECTANCY AT BIRTH: Between 1996 and 2002, the ratio of persons in the 15-64 year-old age group to the population aged 65 and over decreased in the Americas and in all sub-regions, except in North America and the non-Latin Caribbean. However, this indicator remains high in several areas, especially in Central America, the Andean Area, Mexico and Brazil, with values higher than 12:1 (Table 1). Life expectancy at birth (LEB) in the Americas was estimated to be 73.2 years in 2002. This figure is increasing at different rates in all the subregions. Within the Region, the LEB estimate was 77.7 years for North America, with all the other subregions lagging 3.6 to 10 years behind. On average, this indicator for women in the Region is approximately 6.3 years longer than for men, with this difference varying from a low of 5.5 years in the Caribbean to a high of 8 years in Brazil.

## Mortality indicators

OVERALL MORTALITY: It was estimated that the mortality rate in 2002 in the Americas will be 7.2 per 1.000 population (Table 1). In the last two decades of the 20th century, the Region has seen a reduction of about 25% in the mortality rate. This indicator varies little between sub-regions, with rates ranging from 5.1 in Mexico to 8.7 in the Latin Caribbean.

INFANT MORTALITY: The infant mortality rate (IMR) in the Americas is estimated to be around 25.3 deaths per 1,000 live births in 2002, which indicates that a total of 400,000 children in the Region will die before their first birthday (Table 1). However, in 10 years the IMR decreased by almost one-third, from 36.9 deaths per 1,000 live births in 1980-1985. The greatest improvement occurred in Central America, Brazil, and the Latin Caribbean, with reductions of 45%, 34%, and 30% respectively. Since the expected rate of decline is similar in all countries, the subregions that have higher IMR are expected to experience greater absolute declines. The IMR continued to decrease from 1996 to 2002 in all American sub-regions (Table 1). The vast majority of the countries have lowered their IMR for both sexes.

**Table 1: Demographic and mortality indicators for the Americas, by Subregion, 1996-2002**

| | | Sub-region | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Indicators | Year/period | Andean Area | Brazil | Latin Caribbean | Non-latin Caribbean | Southern Cone | Central America | Mexico | North America | Total |
| Population (in thousands) | 2002 | 116,927.9 | 174,706.1 | 32,299.4 | 7,736.8 | 62,696.6 | 37,971.4 | 101,842.4 | 319,861.8 | 854,042.3 |
| Population growth rate (%) | 1996-2002 | 1.8 | 1.3 | 1.1 | 0.7 | 1.3 | 2.4 | 1.6 | 1.0 | 1.3 |
| Urban percentage | 1996 | 72.8 | 79.0 | 84.7 | 61.0 | 61.5 | 46.3 | 73.6 | 76.4 | 74.8 |
| | 2002 | 75.5 | 82.2 | 86.4 | 63.1 | 64.3 | 48.7 | 74.8 | 77.7 | 76.6 |
| Annual urban growth rate (%) | 1996-2002 | 2.4 | 2.0 | 1.7 | 1.7 | 1.5 | 3.3 | 1.8 | 1.3 | 1.7 |
| Annual rural growth rate | 1996-2002 | 0.1 | -1.5 | -0.5 | 0.1 | -0.5 | 1.6 | 0.8 | 0.1 | 0.0 |
| Urbanization (%) | 1996-2002 | 2.3 | 3.4 | 2.2 | 1.5 | 2.0 | 1.7 | 1.0 | 1.2 | 1.7 |
| Births (in thousands) | 2002 | 2,733.1 | 3,373.7 | 653.9 | 140.6 | 1,242.8 | 1,120.6 | 2,273.2 | 4,135.8 | 15,673.6 |
| Birth rate (per 1,000 pop.) | 1996 | 26.2 | 20.7 | 21.7 | 19.9 | 21.1 | 32.5 | 25.1 | 14.5 | 20.2 |
| | 2002 | 23.4 | 19.2 | 20.2 | 18.2 | 19.8 | 29.5 | 22.2 | 12.9 | 18.4 |
| Total fertility rate (children/ woman) | 1996 | 3.1 | 2.3 | 2.7 | 2.3 | 2.7 | 4.1 | 2.8 | 2.0 | 2.5 |
| | 2002 | 2.8 | 2.2 | 2.5 | 2.1 | 2.5 | 3.6 | 2.5 | 1.9 | 2.3 |
| Ratio of adults to elderly persons* | 1996 | 13.8 | 13.3 | 9.6 | 9.0 | 7.3 | 14.4 | 13.9 | 5.3 | 9.8 |
| | 2002 | 13.0 | 12.4 | 9.2 | 9.1 | 7.2 | 13.9 | 12.8 | 5.4 | 9.5 |
| Life expectancy at birth (years) | 1996 | 69.2 | 66.9 | 67.3 | 73.0 | 73.0 | 67.6 | 72.0 | 76.5 | 72.0 |
| | 2002 | 70.9 | 68.3 | 67.8 | 73.9 | 74.1 | 68.9 | 73.0 | 77.7 | 73.2 |
| Mortality rate (per 1,000 pop.) | 1996 | 6.1 | 7.1 | 8.6 | 6.4 | 7.3 | 6.4 | 5.1 | 8.5 | 7.3 |
| | 2002 | 6.1 | 7.0 | 8.7 | 6.4 | 7.2 | 6.0 | 5.1 | 8.3 | 7.2 |
| Infant mortality rate (per 1,000 live births) | 1996 | 37.8 | 43.1 | 41.4 | 23.7 | 22.2 | 38.1 | 31.6 | 7.6 | 28.5 |
| | 2002 | 31.5 | 38.3 | 37.8 | 21.3 | 20.1 | 32.8 | 28.2 | 6.7 | 25.3 |

* The ratio of adults to elderly persons is the number of people between 15 and 64 years of age per person aged 65 or older.

MORTALITY BY BROAD GROUPS OF CAUSES:

Communicable diseases: Among the countries selected for analysis, the greatest decline in cause-specific mortality occurred in communicable diseases, from 95 per 100,000 population in 1980 to 57 per 100,000 in 2000. In the early 1980s, the mortality rate for communicable diseases varied from 12.9 per 100,000 population for females in Canada to 282.4 per 100,000 for males in Ecuador. By the end of the 1990s, the variation in this data ranged from 12.6 per 100,000 for females in Canada to 151.7 per 100,000 for males in El Salvador (Table 2). Marked reductions in mortality from communicable diseases occurred in almost all countries analyzed, except in Barbados, Canada, the United States, and Puerto Rico where rates were lowest (Graph 1). This increase was more likely the result of AIDS among young adults, particularly in males.

CHRONIC DISEASES AND EXTERNAL CAUSES OF DEATHS:

Neoplasms: Between the early 1980's and the end of the 1990's, there was an overall decrease in the mortality rates due to neoplasms in most of the countries analyzed, except for Barbados, Ecuador, Mexico, and Trinidad and Tobago for both sexes, and Canada, Cuba, Dominican Republic, Jamaica, and Paraguay for males only. Among the countries analyzed, at the end of 1990s mortality rates due to neoplasms ranged between 69.2 for females in Puerto Rico to 171.6 for males in Barbados (Table 2). Diseases of the circulatory system: In the Region, the greatest risk of dying continues to be due to diseases of the circulatory system with 214 deaths per 100,000 population, a rate almost twice as high as for neoplasms and 4 times greater than external causes. However, at the end of 1990s mortality rates from this group of diseases also decreased in all countries for both sexes, ranging between 94.7 for females in Canada to 375.2 for males in Brazil (Table 2). In addition, the magnitude of reduction varied from a low of 0.2% for men in Paraguay to a high of 52.8% for men in El Salvador. External causes: Similarly, in many countries there was also a reduction in mortality rates from external causes for both sexes. The exceptions were for men in Brazil with 5.7% , Colombia with 9.4%, Costa Rica with 3.2%, and Puerto Rico with 4.3% and for women in Costa Rica at 2.1%, Paraguay at 17.7%, and Puerto Rico at 4.3%, where rates increased. The mortality rates from external causes at the end of the 1990's ranged from 4.2 for females in Jamaica to 207.3 for males in Colombia among the countries analyzed (Table 2).

## Concluding remarks

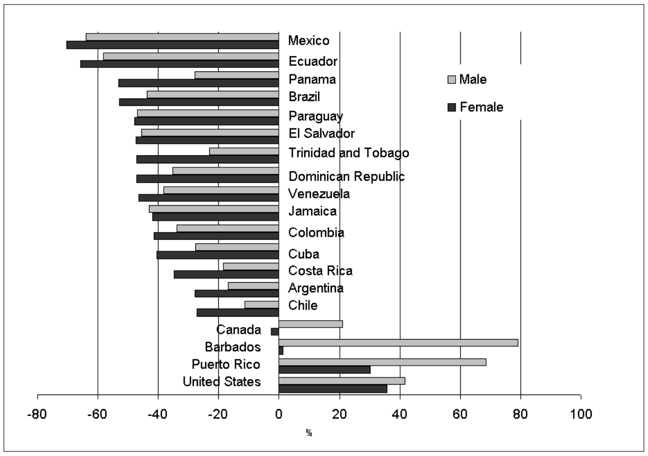
During the latter part of the 20th century, advances in the demographic transition occurred in the Americas, particularly in Latin America and the Caribbean. This process began with an important decline in infant mortality rates and in mortality rates due to communicable diseases. Since 1980, most of the countries have halved their mortality rates from communicable diseases among children under 1 year of age. In addition, besides reductions of mortality rates, especially among younger age groups, for most of the countries of the Americas several factors might have moved this demographic transition forward. These factors include contraception policies, increase of education level, accelerated urbanization, and economic modernization, among others. In particular, the growth of urbanization in the Americas – three quarters of the total population now live in cities – has had important health implications associated on the one hand with the risk factors related to urban settings, and on the other hand with the possible increase in the access to goods and services.

A decline in fertility rates followed and modified these events. An estimated average fertility rate of 3.1 children per woman in 1980-1985 decreased to an estimate of 2.3 children per woman in 2002. These changes in the population's demographic and mortality profiles, especially the declining fertility rates, have changed the overall age composition of the Region's population, contributing to a longer life expectancy

**Table 2: Estimated mortality rates (per 100,000 population) adjusted for age, by broad groups of causes, selected countries of the Americas, end of the 1990s**

| | Communicable diseases | | Neoplasms | | Diseases of the circulatory system | | Perinatal conditions | | External causes | | All other causes | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Country | F | M | F | M | F | M | F | M | F | M | F | M |
| Argentina | 36.2 | 57.5 | 99.2 | 153.6 | 153.4 | 274.8 | 22.7 | 29.6 | 23.5 | 77.7 | 96.3 | 165.1 |
| Barbados | 41.2 | 100.7 | 121.8 | 171.6 | 220.2 | 266.7 | 13.7 | 16.5 | 14.9 | 55.4 | 159.4 | 206.7 |
| Brazil | 75.1 | 122.3 | 101.2 | 155.9 | 245.0 | 375.2 | 49.4 | 64.3 | 30.9 | 139.8 | 165.8 | 264.8 |
| Canada | 12.6 | 26.3 | 107.3 | 163.8 | 94.7 | 182.4 | 6.2 | 7.9 | 19.4 | 55.5 | 66.1 | 104.8 |
| Chile | 51.1 | 94.8 | 115.3 | 160.9 | 118.5 | 202.1 | 8.7 | 10.9 | 23.1 | 107.0 | 102.5 | 172.7 |
| Colombia | 52.7 | 74.2 | 107.0 | 127.5 | 221.4 | 290.3 | 28.0 | 35.6 | 35.2 | 207.3 | 132.9 | 167.5 |
| Costa Rica | 27.9 | 48.0 | 108.0 | 138.1 | 148.8 | 208.8 | 15.5 | 19.1 | 24.1 | 88.9 | 118.1 | 148.6 |
| Cuba | 30.3 | 44.5 | 95.1 | 131.8 | 169.3 | 228.9 | 6.0 | 8.8 | 36.4 | 85.8 | 84.6 | 101.9 |
| Dominican Republic | 64.3 | 89.9 | 73.3 | 99.5 | 214.0 | 267.5 | 52.7 | 60.3 | 21.8 | 66.9 | 126.7 | 161.0 |
| Ecuador | 87.1 | 118.2 | 117.2 | 116.9 | 159.8 | 211.1 | 29.4 | 37.1 | 32.6 | 134.5 | 165.2 | 215.5 |
| El Salvador | 109.7 | 151.7 | 108.6 | 80.8 | 145.9 | 158.3 | 23.8 | 29.5 | 39.5 | 199.0 | 188.4 | 307.0 |
| Jamaica | 39.7 | 51.3 | 127.3 | 162.3 | 279.0 | 315.2 | 15.1 | 16.6 | 4.2 | 14.1 | 176.5 | 216.8 |
| Mexico | 47.7 | 70.7 | 83.0 | 93.6 | 145.9 | 186.5 | 27.1 | 35.7 | 24.9 | 107.3 | 218.5 | 308.4 |
| Panama | 41.5 | 75.3 | 90.2 | 105.6 | 140.0 | 188.6 | 24.5 | 29.6 | 24.3 | 96.6 | 128.3 | 166.3 |
| Paraguay | 94.9 | 122.6 | 80.6 | 82.3 | 250.1 | 307.9 | 37.0 | 46.9 | 27.4 | 87.2 | 115.0 | 137.7 |
| Puerto Rico | 37.7 | 82.7 | 69.2 | 115.0 | 116.4 | 192.4 | 14.4 | 16.6 | 18.8 | 112.3 | 130.2 | 216.1 |
| Trinidad and Tobago | 43.4 | 84.2 | 103.5 | 124.6 | 280.0 | 364.4 | 35.5 | 46.9 | 23.9 | 79.9 | 220.3 | 291.8 |
| United States | 22.0 | 38.2 | 108.9 | 155.0 | 136.1 | 223.1 | 7.9 | 10.5 | 25.2 | 70.2 | 87.6 | 119.4 |
| Venezuela | 55.1 | 81.2 | 99.7 | 110.8 | 185.1 | 261.2 | 29.6 | 38.1 | 26.7 | 124.6 | 121.4 | 154.1 |

**Graph 1: Percentage reduction/increase in estimated communicable disease mortality rate by sex, adjusted for age, in selected countries of the Americas, 1980-2000**




at birth and to the aging of the general population. As the population ages, a new pattern of health services needs and use presents a challenge for the health system.

Although the overall trends of demographic and mortality indicators are described in this article, different degrees of demographic transition can be seen in the American Region. There are countries or territories in more advanced stages of demographic transition, such as Canada, Martinique, Aruba, Montserrat, Bermuda, Barbados, the United States, Cuba and Anguilla, where life expectancies at birth are higher than 76.0 years and fertility rates are lower than 2.0 children per woman. At the same time, there are countries with high fertility rates (>3.5 children per woman) in the presence of low life expectancy at birth (<66.0 years), such as Haiti, Bolivia and Guatemala. To understand the several "demographic transitions" that take place within each sub-region in the America, detailed health analysis is necessary, including the study of cause-specific mortality rates and trends as well as age, gender and social group differences. Some of these approaches will be the subject of additional reports.

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*Source*: Prepared by the Analysis Group of PAHO's Special Program for Health Analysis (SHA) from data published in *Health in the Americas, 2002*, from PAHO's Technical Information System (TIS) and Core Health Database.

# Obituaries

## Ruth Puffer

Dr. Ruth Puffer passed away on 2 September 2002. She was a biostatistician and public health professional born in Berlin, Massachusetts, United States. She obtained her degrees in Public Health from the Johns Hopkins University and Harvard University. She started her career as Director of Statistical Services in the Department of Public Health for the state of Tennessee.

Between 1953 and 1970, Dr. Puffer served as chief of the Department of Health Statistics of the Pan American Health Organization (PAHO), where she played a key role in the Inter-American Investigation of Childhood Mortality. Two of her research studies: "Patterns of Urban Mortality" (1967) and "Patterns of Mortality in Childhood" (1973), had an important influence on the practice of Public Health in the Region. They are still considered classics of the scientific literature and have had an undeniable impact on health services throughout the hemisphere. In 1978, Dr. Puffer received the Abraham Horwitz Award for Interamerican Health and in 2002, she was one of the "Public Health Heroes of the Americas" selected in celebration of the PAHO Centennial.

## Milton Terris

Dr. Milton Terris, an international leader in the field of public health and epidemiology, passed away on 3 October 2002 in South Burlington, Vermont, United States. Dr. Terris worked as a professor and researcher in several schools of Public Health and Medicine in the United States and Canada. His work as an expert in Epidemiology and Health Policy had an important influence on the development of public health in many countries of the world and of the American Region in particular.

In recognition of his work, he was the recipient of multiple awards, including the Sedgwick Memorial Medal of the American Public Health Association and the Abraham Lilienfeld Award of the American College of Epidemiology, both from the United States. Dr. Terris was founder and editor of the *Journal of Public Health Policy* and president of the National Association for Public Health Policy of the United States. In 1988, he participated as editor in "The Challenge of Epidemiology," a PAHO publication that is among the classics in the history of epidemiology in the Region of the Americas.

# Epidemiological Situation of Acute Pesticide Poisoning in Central America, 1992-2000

## Introduction

One of the main problems for humanity in the XXI century is the degradation of the environment. Scientific and technological advances have generated positive developments for humankind, but they have also opened the possibility of altering the planet's ecological balance and affecting the health of populations.

Synthetic pesticides are also included in these scientific and technological developments. They are substances primarily used to prevent and destroy agricultural pests. They are beneficial in such that they control insect infestation and increase agricultural production. However, they are designed to destroy living organisms and therefore also create hazards for both human and animal health, and the environment. Synthetic pesticides have occupied a significant place among the more than 70,000 chemical substances available on the market since 1940 and they have become the principal strategy for the control of pests. Worldwide pesticide production doubled between 1970 and 1985 and sales, which in 1970 represented US$ 2,700 million, at the end of the century had reached an annual US$ 40,000 million. Approximately 2,800 million kilograms (kg) were sold during this period, representing 900 active ingredients and more than 50,000 commercial formulations. The percentage of these substances used in less industrialized countries has increased in the last three decades from 20% to close to 40%.

It is estimated that about 3% of exposed agricultural workers suffer from an episode of acute pesticide poisoning (APP) every year. More than 50% of all APPs occur in less industrialized countries, though the quantity of pesticides used is less. This illustrates the deficient hygiene and safety conditions under which these products are used. In addition to the acute effects, prolonged periods of low level exposure to pesticides can also produce chronic effects such as damages to the central nervous system, congenital malformations, mutagenic effects, cancer, skin, lungs and eye lesions, damage to the immune system, and masculine sterility, among others.

In the seven countries of the Central American Subregion (Belize, Costa Rica, El Salvador, Guatemala, Honduras, Nicaragua and Panama), there has been a constant increase in the use of pesticides. In recent years, it reached an annual average of 45 million kg of active ingredients, imported and formulated in 42 plants located in these countries. Unfortunately, this increase was accompanied by inappropriate use of the products, deficient storage and production conditions, a lack of understanding of the real health effects due to unspecific symptomatology, and a lack of research on the long term effects of these products on health and environmental deterioration. According to the countries' registration, 7,000 annual cases of APP are reported every year in this Subregion. However, underreporting is still considerable due to difficult access of farm workers to health services, erroneous diagnoses, and problems in registration and reporting.

In light of the problem of the intensive pesticide use in the countries of the Central American Subregion, the Pan American Health Organization (PAHO), through the Division of Health and Environment, has implemented a project (PLAGSALUD in Spanish) that is financed by the Danish Agency for International Development (DANIDA), on the occupational and environmental aspects of exposure to pesticides in the Central American Subregion. The purposes of this 10-year project, initiated in 1994, are to significantly reduce the health problems related to pesticides and support the implementation of sustainable agriculture alternatives. To reach this goal, PLAGSALUD has been working in partnership with the ministries of health, agriculture, education, environment, and labor, as well as universities and civil society in each Central American country. Technical cooperation is provided in the following areas: epidemiological surveillance, research, education, interinstitutional coordination, and the strengthening of legislation. Epidemiological surveillance provided valuable information, which was used for the analysis in this report.

## Methodology

The data collection carried out for this analysis made use of several sources of data and involved the participation of people responsible for the surveillance of these problems in the different countries of the subregion.

The data collected on the importation of active ingredients and the use of pesticides by chemical group and by their classification according to which microorganism they control were obtained from registries of the Ministry of Agriculture for the 1992-2000 period. Based on these data, the trend of pesticide importation for this period was analyzed; further, indicators to evaluate the burden of pesticides were constructed, including the kilograms imported per inhabitant in the general population, per inhabitant in the population economically active in agriculture, and per hectare devoted to agriculture.

The data on the number of cases of APP from the countries' epidemiological surveillance system was used for the epidemiological analyses. Taking into account only the cases reported between 1992 and 2000, incidence rates were calculated using the number of cases and deaths reported and each country's population at mid-period. The population data came from projections of the Central American Population Center of the University of Costa Rica. The case-fatality was calculated using the number of deaths due to APP divided by the total of reported APP cases.

These epidemiological data were stratified by sex, age, and cause for the last two years of the series, 1999 and 2000. Proportional analyses were done for each country and for the region. In order to estimate the risk of poisoning in the most exposed population, an indicator was constructed using the reported cases of poisoning of occupational origin as the numerator and the economically active population dedicated to agriculture as denominator. The data on the economically active population were obtained from the Economic Commission for Latin America and the Caribbean (ECLAC) and the proportion of this population involved in agriculture was obtained from the report entitled "State of the Central American Region".

The statistical analysis is descriptive, showing trends of the epidemiological indicators by year and country, with proportional distributions to stratify the information by different variables. The cases of APP by sex and cause were estimated from the proportional distributions presented by the countries in their epidemiological information for these variables.

## Results

### Burden of pesticides in the Central American Subregion

The population of the Central American Subregion is currently nearly 35 million inhabitants, half of which live in rural areas, mainly in Guatemala and Honduras. In the countries of the Central American Subregion and in many others of Latin America, a significant proportion of the economically active population works in the agricultural sector. The highest proportion of the territory devoted to agriculture is found in El Salvador, Costa Rica, and Nicaragua, where the main products are coffee, sugarcane, grains such as rice, beans and corn, vegetables, banana, tobacco, and flowers. Between 85% and 90% of the imported pesticides are used in this sector annually, often by communities that have little access to social security or live in areas of limited health coverage.

The importation of Pesticides in the Central American Subregion has increased progressively. Between 1994 and 2000, it went from 34 to 45 million kg, an increase close to 32% in only 6 years. This subregion presents the highest rate of consumption per capita of these substances, amounting to nearly 1.5 kg of pesticides per person per year. In 2000, the burden of pesticides per economically active person devoted to agriculture in the region (6.7 kg/person) represents five times that of the general population (1.3 kg/person) (Graph 1). From 1992 to the year 2000, the burden of these substances in the Subregion went from 4.5 kg by agricultural worker to 6.7 kg.

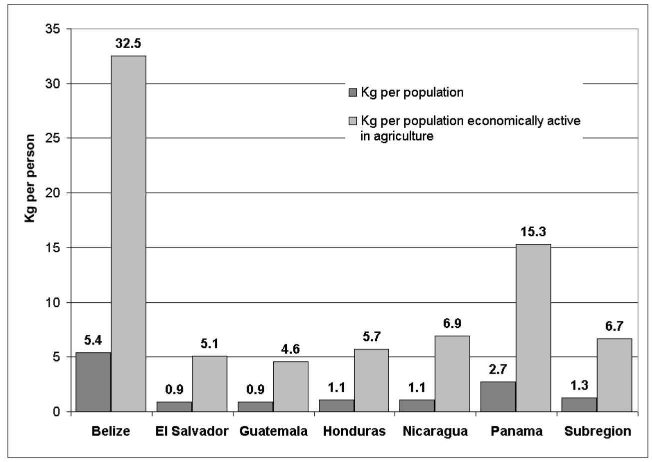
Among the three principal pesticide groups defined by microorganism they control, insecticides and fungicides showed a decline in the Region during the period, whereas herbicides showed a considerable increase, with imports going from 6.3 to 14.6 million kg between 1992 and 2000, an increase of 129%.

### Acute pesticide poisoning

Acute pesticide poisoning has clinical manifestations similar to many common diseases which signs and symptoms or signs during physical examination are not specific. Because of this, APP is a cause of morbidity that is often not recognized. Knowledge of the person's exposure to occupational or environmental factors is of vital importance for diagnosis, treatment, and rehabilitation, as well as for public health purposes. For this reason, it is essential to obtain an adequate history of any occupational or environmental exposure that may cause and even exacerbate a health problem. This also permits to search for other cases in the family, the workplace, or the community and to obtain environmental data. Generally, the registration of cases in Central America is limited in coverage and the levels of underreporting are high. Most of the available data comes from isolated studies. However, efforts have been made recently to strengthen surveillance of APP in countries of the Subregion.

The incidence rate of APP in the Central American Subregion is close to 20 cases per 100,000 population, with a progressively increasing risk for the period, from rates of 6.3 per 100,000 population in 1992 to 19.5 in the year 2000 (Graph 2). This increase may be related to an increase in surveillance efforts and therefore should be taken with caution. There were 6,934 cases of APP in the year 2000. For this year, the greatest number of cases was registered in El Salvador (2,349), followed by Nicaragua (1,651) and Guatemala (1,060). If the risk is analyzed by country and for the period 1998-2000 — when the epidemiological surveillance system was already functioning — high risk countries with respect to the medium incidence rate are Nicaragua and El Salvador, with rates higher than 35 per 100,000 population, and low-risk countries are Honduras, Belize, and Guatemala, with rates lower than 10 per 100,000.

**Graph 1: Imported pesticides by country and in the Central American Subregion, 2000**




The data obtained through the surveillance system show that the 12 pesticides responsible for the greatest number of APP are Paraquat, Aluminium Phosphide, Methyl-Parathion, Metamidophos, Monocrotophos, Chlorpyrifos, Terbufos, Etoprop, Endosulfan, Carbofuran, Methomyl, and Aldicarb. It should be pointed out that these pesticides are of a high toxicity [levels Ia (extremely dangerous) and Ib (highly dangerous) in the WHO toxicological classification of pesticides]. There are less toxic alternatives to all of them and their use could be abandoned.

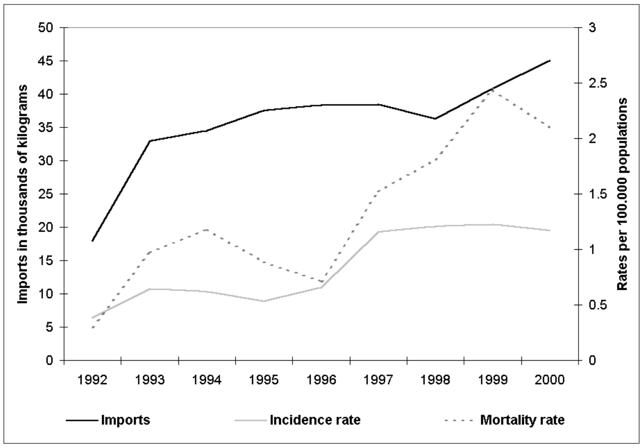
### Mortality from acute pesticide poisoning

The mortality rates also show a rising trend in the period, with a risk of death of 0.3 per 100,000 population in 1992 increasing to 2.1 in 2000 (Graph 2). As in the case of the morbidity data, these could be related to better surveillance and a greater awareness of medical personnel. A slight decline was registered between 1999 and 2000, from 867 to 748 deaths. Comparing the country rates with the average mortality for the 1998-2000 period, El Salvador and Nicaragua are considered high-risk countries with rates higher than 4 per 100,000 population and Belize, Costa Rica and Honduras appear in the low-risk countries with a mortality rate lower than 1.

### Case-fatality of acute pesticide poisoning

The case fatality proportion is obtained by comparing the fatal cases to the observed APP. This proportion oscillated between 4.8% and 10.8% in the Subregion between 1992 and 2000. The low fatality level calculated for 1996 (5.4%) may be due to a better detection of non-fatal APP cases. The

**Graph 2: Pesticide importation trends, pesticide poisoning incidence and mortality rates in countries of the Central American Subregion, 1992-2000**




fatality increase to 11% in 2000 may be due to a gradual improvement of the detection of fatal cases. This proportion is higher in El Salvador, Nicaragua, and Guatemala and indicates the severity of this health problem in comparison with other public health issues in the Subregion. However, this figure may also reflect a greater capture of the fatal forms of poisoning. It is also important to advance efforts to improve the training of health professionals in identifying and managing cases of APP properly.

Relationship between the burden of pesticides and the behavior of poisoning

The number of kilograms of pesticides imported to the Subregion and the incidence rates of APP were compared using the correlation between these two indicators during the study period (1992-2000). A positive correlation was found (Spearman Correlation r=0.83, p=0.005), indicating a steady increase in pesticide imports and in turn an increase in the incidence of APP in the Region over this period. If there is no improvement in occupational safety, this could lead to an increase in the risk of APP associated with pesticide imports and use.

Acute pesticide poisoning according to variables of interest

In people under 15 years of age, 816 cases of APP were registered (5.7 per 100,000 population under age 15) and 27 deaths (0.2 per 100,000) in the Subregion in the year 2000. This risk is smaller than that registered for the total population. Underreporting affecting the entire situation analysis deserves special attention in this age group, even more so because this group is highly vulnerable to exposure to these substances. Acute pesticide poisoning impacts a greater proportion of men, who represent approximately 70% of all cases, with a very similar pattern in all the countries.

The causes of APP presented are based on the following case classification, which depends on the circumstance of exposure:

- <u>Occupational</u>: Exposure to pesticides during work or processes derived from the latter, such as manufacture, formulation, storage, transportation, application, and final disposal.
- <u>Accidental</u>: Exposure to pesticides that occurs unintentionally and unexpectedly.
- <u>Intentional</u>: Exposure to pesticides with intent to cause harm. This includes suicide attempts, suicides, and homicides.

In the year 2000, 36% of the cases of APP were occupational, followed by those with intentional and accidental origins. There are major variations in the proportion of each type of origin by country: in Guatemala, 60% are occupational poisoning, in Belize 50%, in Panama 41%, in Costa Rica 37%, in Nicaragua 33%, and in El Salvador 27%. When considering the cases of occupational APP registered in these countries with respect to the economically active population devoted to agriculture, assuming this population is the most highly exposed, incidences reach 48 per 100,000 agricultural workers in 1999 and 37 in 2000, close to twice the risk registered for the general population. Nicaragua, Panama, and Guatemala show a particularly high risk.

Underregistration

Although the reporting of APP has improved in the last two years, the number of cases reported remains low. There are different reasons for the lack of registration of APP, the most important being: 1) the person with APP does not seek care in health centers (by lack of knowledge of the signs and symptoms, fear of losing their employment, difficulty of access to health services, cultural standards not favorable to seeking care, mild cases that do not seem to require care); 2) the person with APP seeks medical care but diagnosis is not done or not reported correctly; and 3) the person intoxicated seeks medical care, is diagnosed and reported, but for administrative reasons the report is not registered in the epidemiological surveillance system.

In light of this situation, the PLAGSALUD project conducted a study of underregistration in each of the seven countries during the year 2001. In six countries it was accomplished through community surveys and in one through administrative underregistration research (analysis of the information system that supports epidemiological surveillance in the health system). The general underregistration results were the following:

| | |
|---|---|
| Belize: | 99% |
| Costa Rica: | Canton #1: 97.8% |
| | Canton #2: 96.7% |
| | Canton #3: 91.2% |
| | Canton #4: 82.2% |
| El Salvador: | 97% (municipal level) |
| | 77% (departmental level) |
| | 80% (national level) |
| Guatemala: | 97.5% (municipal and departmental levels) |
| Nicaragua: | 98.0% |
| Honduras: | administrative underregistration was less than 20% |
| Panama: | 93.6% |

The previous information implies that, in general, between one and 20 of every 100 cases of APP are reported, except in Honduras where only administrative underreporting was studied.

## Conclusion

One important point to mention is the progressive increase in pesticide imports in the Region over the last decade. This increase was registered in many countries and when the pesticides are classified by the type of organism they are designed to control, herbicides show a rising trend. Compared to the WHO estimates of an average pesticide burden at the global level of 0.6 kilograms per person, the burden in the Region remains very high. For 2000, the Regional incidence rate was close to 20 cases per 100,000 population and the mortality rate was 2.1 per 100,000 population. Cases of acute poisoning and mortality also show a rising trend. This trend may reflect a better registration system or problems due to a poor management or a greater dangerousness of this type of substances. Nicaragua and El Salvador show the highest risk. However, given the increase in imports of these substances in countries such as Guatemala and Honduras, the lower risk may reflect an underregistration problem. The case fatality associated with pesticide poisoning is high. In 2000, 11% of the APP cases resulted in death. As a response, health personnel should be trained in the management of these situations, and strict prevention and control activities should be put in place. Major efforts should be made to develop and implement strategies that lead to a drastic reduction of the use of synthetic pesticides, to the development of alternatives and subsequently to the protection of human health and the environment. Different initiatives supported by PLAGSALUD in the Central American Subregion are presented in Box 1.

## Recommendations for surveillance, prevention, and control of acute pesticide poisoning

In light of these major challenges facing Central America to control these problems, we can mention the following:

- Promote epidemiological surveillance systems that permit the constant monitoring of patterns of the problem both in terms of human health and the environment, in order to correctly direct prevention and control activities in a more effective and pertinent way. This requires the improvement of the data's quality.
- To better analyze occupational poisoning, it is necessary that each country of the region generate more precise and reliable case data.
- Improve epidemiological surveillance actions that are being put in place with regard to: poor completion of notification reports, more detailed analysis by cause and most often found pesticides; period of the year in which the poisoning occurs; toxicological classification of the pesticides; and severity of the poisoning, among others.
- Support the development of alternatives to pesticides, such as integrated pest management (IPM) and organic agriculture, which constitute a production system based on appropriate management practices. These practices should take into account conditions for biological activities in agrosystems to be developed appropriately, i.e. in a less dependent, polluting and dangerous way.
- Promote and organize citizen participation, particularly that of the most exposed workers and communities, permitting direct involvement in the decision-making process in the different territorial entities. For that to happen, access to up-to-date and complete information on pesticides is required.

### Box 1: Initiative of prevention and control of APP supported by PLAGSALUD in the Central American isthmus

The following are among the initiatives developed for the prevention and control of the different health and environmental problems derived from the use of pesticides:

#### Legislation

The ministers of health of the countries of the Subregion ratified, during the XVI Special Meeting of the Health Sector of Central America and the Dominican Republic, an agreement on restrictions and prohibitions of pesticides (Agreement no. 9). Through this agreement, it was requested of the ministries of health, agriculture, environment and natural resources to initiate the process of restricting the 12 pesticides responsible for the greatest morbidity and mortality by APP in the Central American Isthmus (Methyl-parathion, terbufos, etoprop, aldicarb, metamidophos, methomyl, monocrotophos, carbuforan, endosulfan, aluminium phosphide, paraquat and chlorpyrifos). Furthermore, in order to bring about stronger legislative actions, the countries were urged to standardize the prohibition of 107 additional pesticides currently prohibited in one or more countries. El Salvador and Nicaragua have spearheaded this process by prohibiting 35 and 17 pesticides in 2000 and 2001, respectively. In Belize, control is being performed through a classification of pesticides of restricted use, listing the 40 most toxic insecticides. A special license is required to buy these substances.

#### Epidemiological Surveillance

Surveillance of acute pesticide poisoning was incorporated in the surveillance systems of the seven countries. With the information obtained in the countries, it has been possible to design prevention and control strategies to intervene on the risk factors. Furthermore, environmental surveillance has been strengthened through studies of pesticide residues in food in several countries, and the monitoring of the presence of pesticides in the environment, specifically in water, as occurred in the flooded areas of Honduras after Hurricane Mitch.

#### Community participation

One of the most effective and practical results of PLAGSALUD is the creation in the seven countries of over 350 intersectoral local commissions on pesticides (CLIPs for their Spanish name, "Comisión local intersectorial de plaguicidas"), which gather hundreds of members working at the local level, from farmers to government workers, community representatives, and NGO workers. These commissions are the liveliest expression of the day to day work carried out in Central America to reduce the negative effects of pesticides, to educate the general population on the risks of these substances, and to find and apply alternatives to these substances.

#### Education

Educational material has been prepared, both at the subregional and country level, for workers, the community in general, technicians and professionals in the health, agriculture, labor, education, and environmental sectors. Guatemala is making particular efforts in education. In the last three years, 30,000 people have been trained in insecticide management and alternatives to these, with an emphasis in the six regions with greater problems. These educational activities have been carried out using educational materials translated in several Mayan tongues. Formal education has also been encouraged through distance learning courses, continuing medical education of health personnel and other nonmedical personnel working in poisoning prevention and the control of environmental pollution by these substances.

#### Search for alternatives to pesticides

The development of alternatives has meant working with Integrated Pest Management (IPM) and organic agriculture as a priority in all the countries of the Subregion. Guatemala, Nicaragua, and Costa Rica are the countries that devote the greatest land surface to organic production. Through this alternative, the countries hope to obtain a higher quality agricultural production, reduce the use of pesticides, and open new alternatives for small farmers. Currently, 41,000 hectares are used for organic agriculture, for products such as banana, beans, cacao, coffee, and blackberries.

- Establish controls for pesticides posing greater human health and environmental hazard through: prohibition of pesticides in their countries of origin, prohibition of substances belonging to persistent organic pollutants, homogeneity of pesticides prohibited in all the countries of the subregion, strictest controls for the sale of products that have produced the greatest number of APP, adequate elimination of residues and containers, prohibition of application by women and children, and selection of pesticides based on molecules found in fungi, bacteria, and plants that act on the pest organism and induce resistance of the same.
- Better controls on compliance using existing legislation.
- One of the biggest problems in the subregion is the standardization in all the countries of the list of prohibited pesticides. This standardization is required in order to improve controls at customs, in the field, at the points of sale, and generally in the enforcement of existing legislation.
- Improve the conditions of hygiene and safety for farm workers and their families, who are the population with greater exposure to these substances.

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*Source*: Prepared by Dr. Samuel Henao from the Environmental Quality Program (HEQ) of PAHO's Division of Health and Environment (HEP) and by Dr. Maria Patricia Arbelaez from the Public Health Department of the University of Antioquia, Medellin, Colombia.

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# Standardization: A Classic Epidemiological Method for the Comparison of Rates

## Introduction

One of the fundamentals of health situation analysis (HSA) is the comparison of basic health indicators. Among other objectives of HSA, this allows to identify risk areas, define needs, and document inequalities in health, in two or more populations, in subgroups of a population, or else in a single population at different points in time. Crude rates, whether they represent mortality, morbidity or other health events, are summary measures of the experience of populations that facilitate this comparative analysis. However, the comparison of crude rates can sometimes be inadequate, particularly when the population structures are not comparable for factors such as age, sex or socioeconomic level. Indeed, these and other factors influence the magnitude of crude rates and may distort their interpretation in an effect called confounding (box 1).[1, 2, 3]

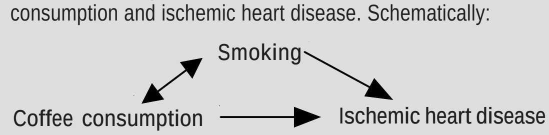
The calculation of specific rates in well defined subgroups of a population is a way of avoiding certain confounding factors. For example, specific rates calculated by age groups are often used to examine how diseases affect people differently depending on their age. However, although this uncovers the patterns of health events in the population and allows for more rigorous comparison of rates, it can sometimes be impractical to work with a large number of subgroups.[4] Furthermore, if the subgroups consist of small pop-

**Box 1: Definition of *Confounding***

A *confounding effect* appears when the measurement of the effect of an exposure on a risk is distorted by the relation between the exposure and other factor(s) that also influence(s) the outcome under study.[1]

Similarly, a *confounding factor* (or confounder) must meet three criteria: 1) to be a known risk factor for the result of interest,[2] 2) to be a factor associated with exposure but not a result of exposure[2] and 3) to be a factor that is not an intermediate variable between them.

An example is that of smoking as a counfounder in the study of coffee consumption as risk factor for ischemic heart disease. The association between coffee consumption and ischemic heart disease may be confounded by smoking. Indeed, smoking is a known risk factor for ischemic heart disease. It is associated with coffee consumption as smokers are usually consumers of coffee, but it is not a result of drinking coffee. Smoking is not an intermediate variable between coffee consumption and ischemic heart disease. Schematically:




Smoking is a *confounder* of the association between coffee consumption and ischemic heart disease.

*Sources:*
(1) Last J. A Dictionnary of Epidemiology. Fourth Edition. New York, New York: Oxford University Press. 2001
(2) Gordis L. Epidemiology. Second Edition. Philadelphia, PA: W.B. Saunders Company. 2000

ulations, the specific rates can be very imprecise. The process of standardization (or adjustment) of rates is a classic epidemiological method that removes the confounding effect of variables that we know — or think — differ in populations we wish to compare. It provides an easy to use summary measure that can be useful for information users, such as decision-makers, who prefer to use synthetic health indices in their activities.

In practice, age is the factor that is most frequently adjusted for. Age-standardization is particularly used in comparative mortality studies, since the age structure has an important impact on a population's overall mortality. For example, in situations with levels of moderate mortality, as in the majority of the countries of the Americas, an older population structure will always present higher crude rates than a younger population.

There are two main standardization methods, characterized by whether the standard used is a population distribution (direct method) or a set of specific rates (indirect method). The two methods are presented below.

## Direct method

In the direct standardization method, the rate that we would expect to find in the populations under study if they all had the same composition according to the variable which effect we wish to adjust or control (such as age, socioeconomic group, or other characteristics) is calculated. We use the structure of a population called "standard", stratified according to the control variable, and to which we apply the specific rates of the corresponding strata in the population under study. We thus obtain the number of cases "expected" in each stratum if the populations had the same composition. The adjusted or "standardized" rate is obtained by dividing the total of expected cases by the standard population. An example is presented in box 2.

An important step in the direct standardization method is the selection of a standard population.[3] The value of the adjusted rate depends on the standard population used, but to a certain extent this population can be chosen arbitrarily, because there is no significance in the calculated value itself. Indeed adjusted rates are products of a hypothetical calculation and do not represent the exact values of the rates. They serve only for comparisons between groups, not as a measure of absolute magnitude.[3] However, some aspects should be taken into account in the selection of the standard population. The standard population may come from the study population (sum or average for example). In this case howev-

**Box 2: Comparison of general age-standardized mortality rates in Mexico and the United States, using the direct method, 1995-1997**

In this example, the standard population that was used is the so-called "old" world standard population defined by Waterhouse (see Box 3). The crude mortality rate for all ages in the United States for 1995-1997 is 8.7 per 1,000 population. In Mexico it is much lower: 4.7 per 1,000 population. We can conjecture that the higher rate in the United States may be due to an older population structure than in Mexico. Therefore, we wish to study the rates of the two countries when controlling for the effect of the age structure difference.

In this example, to use the direct method we need:

- The specific mortality rates by stratum of the characteristic we want to control, in this case age, in each population (i.e. Mexico and the United States)

- A standard population, stratified in the same way

First we calculate the expected number of deaths in both countries, applying the rate of each country to the standard population (columns (4) and (5)). The sum of all the groups gives us the total of expected deaths.

To calculate the adjusted rate, we divide this number by the total standard population.

| | | Age-specific mortality rate per 100,000 population, 1995-1997 | | Expected number of deaths | |
|---|---|---|---|---|---|
| | Standard Population (1) | Mexico (2) | United States (3) | Mexico (4) = (1)x(2)/100,000 | United States (5) = (1)x(3)/100,000 |
| <1 | 2,400 | 1,693.2 | 737.8 | 41 | 18 |
| 1-4 | 9,600 | 112.5 | 38.5 | 11 | 4 |
| 5-14 | 19,000 | 36.2 | 21.7 | 7 | 4 |
| 15-24 | 17,000 | 102.9 | 90.3 | 17 | 15 |
| 25-44 | 26,000 | 209.6 | 176.4 | 55 | 46 |
| 45-64 | 19,000 | 841.1 | 702.3 | 160 | 133 |
| 65+ | 7,000 | 4,967.4 | 5,062.6 | 348 | 354 |
| | 100,000 | | | 639 | 574 |

Age-adjusted mortality rate$_{\text{Mexico}}$ = 6.4 per 1,000 pop. and Age-adjusted mortality rate$_{\text{United States}}$ = 5.7 per 1,000 pop.

When eliminating the effect of the difference in the age structure in both countries, we obtain a rate that is higher in Mexico than in the United States. The conclusion of the comparison of the rates is inversed when using adjusted rates rather than crude rates.

*Source of the data*: Pan American Health Organization. *Perfiles de mortalidad de las comunidades hermanas fronterizas México - Estados Unidos Edición 2000 / Mortality profiles of the Sister Communities on the United States-Mexico border 2000 Edition*. Washington, D.C.: OPS. 2000

**Box 3: "Old" Standard Populations (World and European)**

| Age groups (Years) | World | European |
|---|---|---|
| 0 | 2,400 | 1,600 |
| 1-4 | 9,600 | 6,400 |
| 5-9 | 10,000 | 7,000 |
| 10-14 | 9,000 | 7,000 |
| 15-19 | 9,000 | 7,000 |
| 20-24 | 8,000 | 7,000 |
| 25-29 | 8,000 | 7,000 |
| 30-34 | 6,000 | 7,000 |
| 35-39 | 6,000 | 7,000 |
| 40-44 | 6,000 | 7,000 |
| 45-49 | 6,000 | 7,000 |
| 50-54 | 5,000 | 7,000 |
| 55-59 | 4,000 | 6,000 |
| 60-64 | 4,000 | 5,000 |
| 65-69 | 3,000 | 4,000 |
| 70-74 | 2,000 | 3,000 |
| 75-79 | 1,000 | 2,000 |
| 80-84 | 500 | 1,000 |
| 85+ | 500 | 1,000 |
| Total | 100,000 | 100,000 |

*Source*: Waterhouse J. y Col. (Eds.). Cancer incidence in five continents. Lyon, IARC, 1976.

er, it is important to ensure that the populations do not differ in size, since a larger population may unduly influence the adjusted rates.[5] The standard population may also be a population without any relation to the data under study, but in general, its distribution with regard to the adjustment factor should not be radically different from the populations we wish to compare.

The comparative study of adjusted rates may be carried out in different ways: we can calculate the absolute difference between the rates, their ratio, or the percentage difference between them. Obviously, this comparison is valid only when the same standard was used to calculate the adjusted rates. When the national standards change (as in the United States in 1999 for example, when a new standard was adopted based on the 2000 population instead of the 1940 standard), the time series have to be recalculated at all levels. Updating the standard populations provides a more current common standard. For comparison of rates from different countries, the standard population used by WHO and PAHO is the so-called "old" standard population defined by Waterhouse.[6] The age distribution of this population is shown in Box 3.

The direct method is most often used. However, it requires rates specific to population strata corresponding to the variable of interest in all the populations we wish to compare, which are sometimes not available. Even when these specific rates are available for all the subgroups, they are sometimes calculated from very small numbers and can be very imprecise. In this case, the indirect standardization method is recommended.[3]

## Indirect method

Indirect standardization is different in both method and interpretation. An example of adjustment using the indirect method is presented in box 4. Instead of using the structure of the standard population, we utilize its specific rates and apply them to the populations under comparison, previously stratified by the variable to be controlled. The total of expected cases is obtained this way. The Standardized Mortality Ratio (SMR) is then calculated by dividing the total of observed cases by the total of expected cases. This ratio allows to compare each population under study to the standard population. A conclusion can be reached by simply calculating and looking at the SMR. A SMR higher than one (or 100 if expressed in percentage) indicates that the risk of dying in the observed population is higher than what would be expected if it had the same experience or risk than the standard population. On the other hand, a SMR lower than one (or 100) indicates that the risk of dying is lower in the observed population than expected if its distribution were the same as the reference population. The actual adjusted rates can also be calculated using the indirect method by multiplying the crude rate of every population by its SMR.[4] Just like in the direct method, a single value is obtained for every population which, even though it only represents an artificial number, takes into account the differences in the compositions of the populations.

Standardized Mortality Ratios are frequently used in epidemiology to compare different study groups, because they are easy to calculate and also because they provide an estimate of the relative risk between the standard population and the population under study. However, it is important to know that there are instances when this comparison is not adequate, like for example when the ratios of the rates in the groups under study and in the population of reference are not homogeneous in the different strata.[7] However, the comparison between each group and the population of reference is always relevant. The SMRs of different causes in a population may also be calculated using a single standard.

## Conclusion

As with any summary measure, adjusted rates may hide great differences between groups, which can be of importance to explain changes in the rates due to or associated with the variable that we wish to adjust for, for example. Nevertheless, whenever possible it is important to analyze the specific rates along with the adjusted rates. The two methods used in a single population should lead to the same conclusions. If it were not the case, the situation in the different population strata requires more in-depth research.[4]

One of the reasons for sometimes limited use of these methods is the lack of tools or instruments that simplify it. To respond to this need, the General Direction of Public Health of the Xunta de Galicia and PAHO's Special Program for Health Analysis have developed the "EpiDat" computer package for analysis of tabulated data. EpiDat is distributed free of charge via the Internet at: http://www.paho.org/Spanish/SHA/epidat.htm. A newer version of this package will be issued soon. The software SIGEpi (see http://www.paho.org/English/sha/be_v22n3-SIGEpi.htm), which combines the capacity of a geographic information system with epidemiological tools, also allows to generate adjusted rates.

In short, adjusted rates allow for more exact comparisons between populations. This is important because it can be used in setting priorities between groups. Nevertheless, the crude rates are the only indicators of the real dimension or magnitude of a problem and hence remain valuable public health tools.

**Box 4: Use of indirect standardization to compare mortality in the Colombian department of Vichada and mortality in Colombia in general, 1999**

The crude mortality rate in Colombia in 1999 was 4.4 per 1,000 population, with variations between 1.8 per 1,000 population in the department of Vichada and 6.9 per 1,000 in Quindio.[1] We would like to study the possible significant differences in the observed mortality (or in the risk of dying) in the country and in its departments. The case of the state of Vichada is presented in this example.

In this case, in order to use the indirect method we need:

- The age-specific mortality rates by age group in Colombia
- The population of the state of Vichada stratified by age
- The total number of deaths observed in the department of Vichada

The first step is to calculate the expected number of deaths in Vichada by applying the standard rates to the population of the department (column (3) = (1) x (2)). Then the calculated deaths are summed up and the SMR is calculated by dividing the total number of observed deaths by the expected deaths.

| | Age-specific mortality rates, per 100,000 pop. Colombia, 1999[1] (1) | Population of the Department of Vichada[1] (2) | Observed deaths in Vichada, 1999[1] | Expected deaths in Vichada (3) |
|---|---|---|---|---|
| 0-4 | 339 | 2,364 | 61 | 39 |
| 5-14 | 34 | 4,390 | 5 | 7 |
| 15-44 | 219 | 10,002 | 27 | 27 |
| 45-64 | 752 | 2,503 | 22 | 53 |
| 65 and more | 4,573 | 513 | 27 | 84 |
| | | 19,772 | 142 | 267 |

$SMR_{vichada\ (\%)} = \frac{142}{267} \times 100 = 53\%$ The SMR of 53% indicates that in the population of Vichada the risk of dying is 47% less than expected according to the mortality standards of all of Colombia, controlling for the age variable.

*NOTE: Confidence interval for SMRs*

The confidence interval provides the range of values within which we expect to find the real value of the indicator under study, with a given probability. That way, it gives an estimate of the potential difference between what is observed and what is really happening in the population, which helps in interpreting the value of the observed indicator. The 95% confidence interval is the most used. As mentioned previously, it indicates the range of values within which we expect to find the real value of the indicator, with a probability of 95%.

In the case of the SMR, the calculation of the confidence interval can be carried out in the following way:

1) First, the Standard Error (SE) for the SMR is calculated using the following formula: $SE = \frac{SMR}{\sqrt{observed\ \ deaths}}$

2) The 95% Confidence Interval (CI) is calculated as follows: $CI\ (95\%) \Rightarrow SMR \pm (1{,}96\ \times SE)$ where 1.96 is the value of the Z distribution with a level of confidence of 95%. It is assumed that the values follow a normal distribution.

In this example: $SE_{Vichaca}$ = 15.9 and $CI_{Vichaca}$ (95%) = [174.1 ; 205.9]

The confidence interval indicates that we know with a probability of 95% that the SMR's value is between 174.1 and 205.9.

*Source of the data*:

(1) Ministerio de Salud de Colombia, Instituto Nacional de Salud de Colombia, PAHO/WHO Representation in Colombia. *Situación de Salud en Colombia, Indicadores Básicos 2002*. Bogotá, Colombia: Ministerio de Salud, PAHO; 2002.

(2) Ministerio de Salud de Colombia. *La Salud en Colombia - Diez años de información*. Santafé de Bogotá, Colombia. 1994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(5) Kramer S. *Clinical Epidemiology and Biostatistics. A primer for Clinical Investigators and Decision-makers*. Berlin Heidelberg, German: Springer-Verlag. 1988

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(7) Szklo M, Nieto J. *Epidemiology, Beyond the basics*. Gaithersburg, MD: Aspen Publishers, Inc. 2000

(8) Xunta de Galicia, Consellería de Sanidade e Servicios Sociais. Pan American Health Organization, Special Program for Health Analysis. *Análisis Epidemiológico de Datos Tabulados (Epidat), Version 2.1* [Computer software for Windows]; 1998


*Source*: Prepared by the Analysis Group of PAHO's Special Program for Health Analysis (SHA)

# *Case Definitions*
# Cutaneous Leishmaniasis

## Rationale for surveillance
Cutaneous leishmaniasis is endemic in over 70 countries. The yearly incidence is estimated at 1,500,000 cases. The disease has several clinical forms: localized cutaneous leishmaniasis, diffuse cutaneous leishmaniasis, the most difficult to treat, and (in the western hemisphere mainly) mucocutaneous leishmaniasis, which is the most severe form as it produces disfiguring lesions and mutilations of the face. In foci where man is believed to be the sole reservoir (anthroponotic foci), epidemics are linked to human migrations from rural to poor suburban areas; in zoonotic foci, where mammals are the reservoirs, epidemics are related to environmental changes and movement of non-immune people to rural areas.

Surveillance is essential to establish disease impact and to monitor efforts towards the control of disease and the detection of epidemics.

## Recommended case definition
*Clinical description*
Appearance of one or more lesions, typically on uncovered parts of the body. The face, neck, arms, and legs are the most common sites. At the site of inoculation a nodule appears, and may enlarge to become an indolent ulcer. The sore remains in this stage for a variable period of time before healing, and typically leaves a depressed scar. Other atypical forms may occur. In some individuals, certain strains can disseminate and cause mucosal lesions. These sequelae involve nasopharyngeal tissues and can be very disfiguring.

*Laboratory criteria for diagnosis*
- positive parasitology (stained smear or culture from the lesion)
- mucocutaneous leishmaniasis only: positive serology (IFA, ELISA).

## Case classification
*WHO operational definition*
A case of cutaneous leishmaniasis is a person showing clinical signs (skin or mucosal lesions) with parasitological confirmation of the diagnosis (positive smear or culture) and/or, for mucocutaneous leishmaniasis only, serological diagnosis.

## Recommended types of surveillance
At peripheral level individual patient records must be retained for investigation and case management.

Routine monthly reporting of aggregated data of cases from periphery to intermediate and central level.

Active case finding through surveys of selected groups or mass surveys (standardized and periodical) is an alternative to estimate the prevalence of cutaneous leishmaniasis.

**International**: annual reporting from central level to WHO (limited number of countries).

## Recommended minimum data elements
*Individual patient records at peripheral level:*
<u>Leishmaniasis data:</u> clinical features, date of diagnosis, parasitological (Mucocutaneous leishmaniasis only) and serological diagnosis, *Leishmania* species, treatment outcome.

<u>Identification data:</u> unique identifier, age, sex, geographical information, past travels, duration of stay at current residence.

*Aggregated data for reporting:*
Number of cases by age, sex, type of diagnosis.

## Recommended data analysis, presentation, reports
**Tables:** Incidence by geographical area, by age, by sex, by type of diagnosis, by month / year.

Point prevalence (if active case detection).

**Maps:** Incidence by village.

## Principal uses of data for decision-making
- Evaluate the real extent of the problem and the main populations at risk
- Improve and focus the control activities
- Improve management and follow-up of cutaneous leishmaniasis, disseminated cutaneous leishmaniasias and mucocutaneous leishmaniasis patients (WHO guidelines)
- Identify technical and operational difficulties
- Evaluate impact of control interventions
- Anticipate epidemics

## Special aspects
The prevalence of cutaneous leishmaniasis tends to be grossly underestimated because most of the official data are obtained through passive case detection only. Other factors that may lead to misdiagnosis or non-diagnosis are: wide scatter of foci, limited access to medical facilities, scarcity of diagnostic facilities, and limited or irregular availability of first-line drugs.

*Source*: "WHO Recommended Surveillance Standards, Second edition, October 1999", WHO/CDS/CSR/ISR/99.2

# Visceral leishmaniasis

## Rationale for surveillance

Visceral leishmaniasis is endemic in over 60 countries. The incidence is estimated at 500,000 cases each year. It is the most severe form of leishmaniasis and it can be fatal in the absence of treatment. Deadly epidemics frequently occur in the anthroponotic foci of Bangladesh, India, Nepal, and Sudan, where man is believed to be the sole reservoir. Surveillance is essential in establishing disease impact and monitor efforts towards disease control and detecting epidemics.

## Recommended case definition

*Clinical description*

An illness with prolonged irregular fever, splenomegaly and weight loss as its main symptoms.

*Laboratory criteria for diagnosis*

- positive parasitology (stained smears from bone marrow, spleen, liver, lymph node, blood, or culture of the organism from a biopsy or aspirated material)
- positive serology (IFA, ELISA).

## Case classification

*WHO operational definition:*

A case of visceral leishmaniasis is a person showing clinical signs (mainly prolonged irregular fever, splenomegaly, and weight loss) with serological (at geographic area level) and/or parasitological confirmation (when feasible at central level) of the diagnosis. In endemic malarious areas, visceral leishmaniasis should be suspected when fever lasts for more than two weeks and no response has been achieved with anti-malaria drugs (assuming drug-resistant malaria has also been considered).

## Recommended types of surveillance

Routine monthly reporting of aggregated data from periphery to intermediate and central level.

Active case finding through surveys of selected groups or mass surveys (standardized and periodical) is an alternative to estimate the prevalence of visceral leishmaniasis.

**International**: annual reporting from central level to WHO (limited number of countries).

## Recommended minimum data elements

*Individual patient records at peripheral level:*

Identification data: Unique identifier, age, sex, geographic information, travel history, duration of stay at current residence.

Leishmaniasis data: Clinical features, date of diagnosis, serological/parasitological diagnosis, *Leishmania* species, treatment outcome.

*Aggregated data for reporting:*

Number of cases by age, sex, type of diagnosis.

## Recommended data analysis, presentation, reports

*Tables:*

Incidence by geographic area, age, sex, type of diagnosis, risk group, by clinical features, by month/year.

Point prevalence (if active case detection).

## Principal uses of data for decision-making

- Evaluate the real extent of the problem and the main populations at risk
- Improve and focus the control activities
- Identify technical and operational difficulties
- Evaluate impact of control interventions
- Anticipate epidemics

## Special aspects

Visceral leishmaniasis tends to be largely underreported because most of the official data are obtained through passive case detection only. The number of people exposed to infection or infected without any symptoms is much more important than the number of detected cases.

*Source*: "WHO Recommended Surveillance Standards, Second edition, October 1999", WHO/CDS/CSR/ISR/99.2

# Epidemiological Calendar

As in previous years, we are including the Epidemiological Calendar for easy reference and use.

The Epidemiological Calendar includes the 365 days of the year, which are grouped in 52 weeks. Its use during surveillance activities is important because by standardizing the time variable, it provides a means to compare events that occur in a given year or during a specific period to others occurring at a later time or in other countries.

The 2002 Epidemiological Calendar begins on the last week of 2002. This is due to the fact that 1) the epidemiological weeks all start on Saturday, and 2) to determine the first epidemiological week of the year, we must choose the first Saturday in January that follows four or more days in January. Consequently, the first epidemiological week of 2003 starts on Sunday, 29 December 2002, and ends on Saturday, 4 January 2004.

# *Epidemiological Calendar 2003*

| EW | | S | M | T | W | Th | F | S | |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Dec | 29 | 30 | 31 | 1 | 2 | 3 | 4 | Jan |
| 2 | Jan | 5 | 6 | 7 | 8 | 9 | 10 | 11 | Jan |
| 3 | Jan | 12 | 13 | 14 | 15 | 16 | 17 | 18 | Jan |
| 4 | Jan | 19 | 20 | 21 | 22 | 23 | 24 | 25 | Jan |
| 5 | Jan | 26 | 27 | 28 | 29 | 30 | 31 | 1 | Feb |
| 6 | Feb | 2 | 3 | 4 | 5 | 6 | 7 | 8 | Feb |
| 7 | Feb | 9 | 10 | 11 | 12 | 13 | 14 | 15 | Feb |
| 8 | Feb | 16 | 17 | 18 | 19 | 20 | 21 | 22 | Feb |
| 9 | Feb | 23 | 24 | 25 | 26 | 27 | 28 | 1 | Mar |
| 10 | Mar | 2 | 3 | 4 | 5 | 6 | 7 | 8 | Mar |
| 11 | Mar | 9 | 10 | 11 | 12 | 13 | 14 | 15 | Mar |
| 12 | Mar | 16 | 17 | 18 | 19 | 20 | 21 | 22 | Mar |
| 13 | Mar | 23 | 24 | 25 | 26 | 27 | 28 | 29 | Mar |
| 14 | Mar | 30 | 31 | 1 | 2 | 3 | 4 | 5 | Apr |
| 15 | Apr | 6 | 7 | 8 | 9 | 10 | 11 | 12 | Apr |
| 16 | Apr | 13 | 14 | 15 | 16 | 17 | 18 | 19 | Apr |
| 17 | Apr | 20 | 21 | 22 | 23 | 24 | 25 | 26 | Apr |
| 18 | Apr | 27 | 28 | 29 | 30 | 1 | 2 | 3 | May |
| 19 | May | 4 | 5 | 6 | 7 | 8 | 9 | 10 | May |
| 20 | May | 11 | 12 | 13 | 14 | 15 | 16 | 17 | May |
| 21 | May | 18 | 19 | 20 | 21 | 22 | 23 | 24 | May |
| 22 | May | 25 | 26 | 27 | 28 | 29 | 30 | 31 | May |
| 23 | Jun | 1 | 2 | 3 | 4 | 5 | 6 | 7 | Jun |
| 24 | Jun | 8 | 9 | 10 | 11 | 12 | 13 | 14 | Jun |
| 25 | Jun | 15 | 16 | 17 | 18 | 19 | 20 | 21 | Jun |
| 26 | Jun | 22 | 23 | 24 | 25 | 26 | 27 | 28 | Jun |
| 27 | Jun | 29 | 30 | 1 | 2 | 3 | 4 | 5 | Jul |
| 28 | Jul | 6 | 7 | 8 | 9 | 10 | 11 | 12 | Jul |
| 29 | Jul | 13 | 14 | 15 | 16 | 17 | 18 | 19 | Jul |
| 30 | Jul | 20 | 21 | 22 | 23 | 24 | 25 | 26 | Jul |
| 31 | Jul | 27 | 28 | 29 | 30 | 31 | 1 | 2 | Aug |
| 32 | Aug | 3 | 4 | 5 | 6 | 7 | 8 | 9 | Aug |
| 33 | Aug | 10 | 11 | 12 | 13 | 14 | 15 | 16 | Aug |
| 34 | Aug | 17 | 18 | 19 | 20 | 21 | 22 | 23 | Aug |
| 35 | Aug | 24 | 25 | 26 | 27 | 28 | 29 | 30 | Aug |
| 36 | Aug | 31 | 1 | 2 | 3 | 4 | 5 | 6 | Sep |
| 37 | Sep | 7 | 8 | 9 | 10 | 11 | 12 | 13 | Sep |
| 38 | Sep | 14 | 15 | 16 | 17 | 18 | 19 | 20 | Sep |
| 39 | Sep | 21 | 22 | 23 | 24 | 25 | 26 | 27 | Sep |
| 40 | Sep | 28 | 29 | 30 | 1 | 2 | 3 | 4 | Oct |
| 41 | Oct | 5 | 6 | 7 | 8 | 9 | 10 | 11 | Oct |
| 42 | Oct | 12 | 13 | 14 | 15 | 16 | 17 | 18 | Oct |
| 43 | Oct | 19 | 20 | 21 | 22 | 23 | 24 | 25 | Oct |
| 44 | Oct | 26 | 27 | 28 | 29 | 30 | 31 | 1 | Nov |
| 45 | Nov | 2 | 3 | 4 | 5 | 6 | 7 | 8 | Nov |
| 46 | Nov | 9 | 10 | 11 | 12 | 13 | 14 | 15 | Nov |
| 47 | Nov | 16 | 17 | 18 | 19 | 20 | 21 | 22 | Nov |
| 48 | Nov | 23 | 24 | 25 | 26 | 27 | 28 | 29 | Nov |
| 49 | Nov | 30 | 1 | 2 | 3 | 4 | 5 | 6 | Dec |
| 50 | Dec | 7 | 8 | 9 | 10 | 11 | 12 | 13 | Dec |
| 51 | Dec | 14 | 15 | 16 | 17 | 18 | 19 | 20 | Dec |
| 52 | Dec | 21 | 22 | 23 | 24 | 25 | 26 | 27 | Dec |
| 53 | Dec | 28 | 29 | 30 | 31 | 1 | 2 | 3 | Jan |

# Course Announcements

## II Internet-based Certificate Program in Epidemiology for Public Health Managers in Spanish

The Bloomberg School of Public Health of the Johns Hopkins University and PAHO's Special Program for Health Analysis announce the **II Internet-based Certificate Program in Epidemiology for Public Health Managers.**

This program provides structured training in Epidemiology for Managing Public Health Services in the Americas using a network-based training model and a team-building approach to enhance the effectiveness of the practice of epidemiology. It covers four integrated core courses, three of which are internet-based. The first course, of a one-week duration, is given on-site at the Johns Hopkins University in Baltimore, Maryland, United States.

The courses offered are:

*Introduction to Online Learning* (Internet), which introduces students to multiple facets of learning via the Internet.

*Principles of Epidemiology for Managers*, which introduces principles and methods of epidemiologic investigation used in the prevention of public health problems.

*Epidemiologic Methods for Planning and Evaluating Health Services* (Internet), which reviews different epidemiologic techniques and designs as they relate to assessment of health care needs, priority setting, risk assessment, and program evaluation.

*Problem Solving in Public Health* (on-site), which uses different public health problems to illustrate the problem-solving process and methodology.

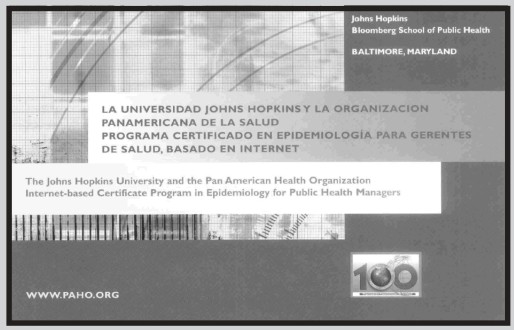
*Tentative dates of the program*: March - October 2003

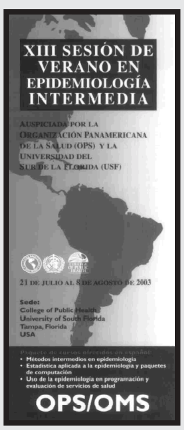
*General requirements:*
- Postgraduate training in epidemiology and biostatistics
- To be in charge of or participate in a public health program or service
- Letter of intention indicating interest in the program
- Curriculum Vitae
- 2 professional recommendation letters
- 1 Photograph

*Registration cost*: US$ 5,000 + costs for the one-site stay

*Deadline for sending application*: 14 January 2003

*Applications should be sent to*: Special Program for Health Analysis, Pan American Health Organization, 525 23rd Street, NW, Washington, DC 20037. Tel: (202) 974-3508. Email: sha@paho.org




## XIII Summer Session in Intermediate Epidemiology in Spanish

The *XIII Session in Intermediate Epidemiology*, sponsored by PAHO's Special Program for Health Analysis, will take place in July and August, 2003 at the College of Public Health of the University of South Florida in Tampa, Florida.

The Intermediate Session will be held from July 21 to August 8, 2003 and will include three courses: Intermediate Methods in Epidemiology; Statistics applied to Epidemiology and the Use of Software Packages; and Use of Epidemiology in the Programming and Evaluation of Health Services.

Students are required to have had approved training in Epidemiology. Courses will be conducted in Spanish, but participants must be able to read English. Applications must be received before *April 15, 2003*.

*For more information and application, contact*: Ms. Clara Ochoa, Special Program for Health Analysis (SHA), Pan American Health Organization, 525 Twenty-third Street, NW, Washington, DC 20037. Tel: (202) 974-3508, Fax: (202) 974-3508, email: sha @paho.org



**PAHO's Epidemiological Bulletin is published quarterly in English and Spanish. Catalogued and indexed by the United States National Library of Medicine. Printed on acid-free paper.**

**Internet: http://www.paho.org/english/sha/beindexe.htm**

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