Technical Notes

General Considerations

As part of the Pan American Health Organization's (PAHO) constitutional mandate to disseminate information on the health situation and trends in the Region of the Americas, this on-line publication presents mortality data submitted by individual countries of the Americas, as well as other useful health information, for dissemination to the international health community. The statistical information presented in this publication was prepared by the Unit of Health Analysis and Statistics (HDM/HA) of PAHO, which was also responsible for the selection, tabulation and technical review of the data presented. The data collection process includes technical collaboration with the Member Countries to strengthen routine national and vital statistics systems. Analyses based on information shown in this publication can be found in the PAHO publications: *Health in the Americas, 2007 Edition*, (to be published) and the *Annual Report of the Director,* as well as on the PAHO website http://www.paho.org.

Sources of Data

Population

Mid-year population estimates were provided by The Population Division of the United Nations, the 2004 Revision[1], and were utilized in the construction of rates by cause of death, age and sex. In Chapter VI, population estimates are provided for countries of the Americas in Tables 1, 2, and 3 for selected years. For countries with an estimated population less than 100,000 in 2000, for which Population Division estimates are not available, population estimates from the United States Census Bureau's International Data Base or from the country's own estimate of population were utilized. This provision only affected the smaller countries of the Caribbean, where estimates from the country were generally utilized. Population estimates by sex were constructed for the following age groups: under 1, 1–4, 5–14, 15–24, 25–44, 45–

64, and 65 years and over, based on single year of age estimates provided by the Population Division to PAHO. Natality or live birth data were provided from the countries' vital registration systems by sex and used in the denominator to calculate rates for infant deaths. When live birth data were not available, the under 1 population estimate was used instead to calculate the infant mortality rate.

Mortality

This publication shows detailed cause of death statistics according to both the *International Statistical Classification of Diseases and Related Health Problems - Tenth Revision* (ICD-10)[2] and *Manual of the International Statistical Classification of Diseases, Injuries and Causes of Death, Ninth Revision* (ICD-9)[3].

The mortality data presented in Chapters I - V is derived from national vital statistics sources, obtained through national civil registration systems and refers to resident deaths only. These data are routinely provided to PAHO by countries of the Americas. For ICD Revisions up to ICD-9 data are stored in the Regional Mortality Database according to the cause groups of the PAHO Form A. In turn, the cause groups used on this Form are specific to the particular revision of the International Classification of Diseases (ICD) that was in use in the years to which the data pertain (see the section on available mortality data in PAHO, below and Annex Table 3). ICD-10 data is currently stored in an electronic format similar to the ones sent by the country. All the data included in Chapters I to V of the publication refer to years during which either ICD-9 was in use or to ICD-10, now in current use. Mortality data shown in this publication have been tabulated by age according to broad age groups: under 1, 1–4, 5–14, 15–24, 25–44, 45–64, and 65 years and over. Deaths, for which the sex was unknown, although not shown

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[1] United Nations Population Division. *World Population Prospects: The 2004 Revision, Volume II: The Sex and Age Distribution of the World Population.* United Nations New York, 2005.

[2] World Health Organization. *International Statistical Classification of Diseases and Related Health Problems. Tenth Revision.* Vols. 1-3. Geneva, WHO, 1992-1994.

[3] World Health Organization. *Manual of the International Statistical Classification of Diseases, Injuries and Causes of Death, Ninth Revision (1975),* Geneva, WHO, 1975. (Vol. 1 & 2)

separately, are included in the totals. In Chapters I to V, the number of deaths not stated by age are shown for each sex. Accordingly, the total number of deaths by sex will not always add up to the totals shown or to the totals for both sexes. Tabulations of cause of death statistics are based solely on the underlying cause of death, which is defined by the World Health Organization (WHO) as the disease, or injury that initiated the sequence of events leading directly to death or as the circumstances of the accident or violence that produced the fatal injury.

Organization of the Contents of *Health Statistics from the Americas, 2006 Edition*

This publication updates previous publications in the same series with registered mortality data received by PAHO during 2003-2005 from countries of the Americas. The last edition was published electronically at http://www.ingentaconnect.com/content/paho/paho 591. The special topic: The Ten Leading Causes of Death in Selected Countries of the Americas is presented in this issue and highlights mortality statistics on the ten leading causes of death in 31 selected countries of the Americas for the latest two or three years. This section is followed by six detailed statistical chapters -- five on mortality, a chapter on selected demographic variables and an Annex with nine reference tables. The chapters are titled as follows:

Chapter I: *Average annual deaths and estimated rates per 100,000 population from selected groups of causes, by age group, sex, and country, around 1985 and last three years available*;

Chapter II: *Deaths and estimated rates per 100,000 population by age group and sex, and male:female ratio, for cause groups of the PAHO 6/61 List (ICD-9), by country and year;*

Chapter III: *Deaths and rates per 100,000 population by age group and sex, and male:female ratio, for broad cause groups of the PAHO 6/61 List (ICD-9), by country and year;*

Chapter IV: *Deaths and estimated rates per 100,000 population by age group and sex, and male:female ratio, for cause groups of the PAHO 6/67 List (ICD-10), by country and year;*

Chapter V: *Deaths and rates per 100,000 populations by age group and sex, and male:female ratio, for broad cause groups of the PAHO 6/67 List (ICD-10), by country and year;*

Chapter VI: *Selected Demographic Estimates and Projections:*

1. *Annual interpolated mid-year population, by country, 1985, 1990, 1995, and 2000-2005;*
2. *Population (thousands) by age group and sex, by country, 1995, 2000, 2005, 2010;*
3. *Annual rate of population change (percent), 1970-1975 to 2015-2020;*
4. *Crude birth rates (per 1,000 population), by country, 1970-1975 to 2015-2020;*
5. *Total fertility (children per women), by country, 1970-1975 to 2015-2020;*
6. *Crude death rates (per 1,000 population), by country, 1970-1975 to 2015-2020;*
7. *Infant mortality rates (per 1,000 live births), by country, 1970-1975 to 2015-2020;*
8. *Life expectancy at birth (years), by sex and country, 1970-1975 to 2015-2020.*

Annex

1. *Status of death registries in selected countries of the Americas, around 2000;*
2. *Percentage of registered deaths assigned to symptoms, signs and ill-defined conditions (ICD-9: 780-799; ICD-10: R00-R99), by country, around 1985 and 2000;*
3. *PAHO List A9 used for tabulation and collection of registered mortality data coded according to ICD-9;*
4. *PAHO List M9 used for abbreviated tabulation of ICD-9 coded mortality data;*
5. *PAHO 6/61 List for tabulation of mortality by cause for ICD-9 (Chapters II, III);*
6. *PAHO 6/67 List for tabulation of mortality by cause for ICD-10 (Chapters IV, V);*

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7. *Detailed mortality data available in the regional mortality databases from 1982-2003 of PAHO, as of 30 November 2005.*
8. PAHO/WHO ranking list to determine leading causes of death in ICD-9.
9. PAHO/WHO ranking list to determine leading causes of death in ICD-10.

The data shown in Chapters I to V was provided by the countries on electronic media, on PAHO/WHO Forms, and in printed reports and publications. All the country-year units summarize vital statistics data derived from information obtained through national civil registration systems and coded according to ICD-9 or ICD-10. As noted, the information for ICD-9 is stored in the PAHO database in A List format (Annex Table 3), although countries may have provided their data in greater detail or even at the level of individual deaths. ICD-10 data, in contrast, is stored in a format similar to which the country sent it.

Chapter I shows the average annual number of deaths with estimated and age standardized rates per 100,000 population for 31 selected cause groups by country, sex, and age group around 1985, and for the last three years available. The averages have been rounded to the nearest integer and summations by age group and sex may not add to the average totals shown. The age-adjusted rates were calculated by the direct method and use the world standard population, which is shown in Table 2 at the end of the Technical Notes section.

Chapters II to V contain summarized mortality data for country-year units that became available and were included in the Regional mortality database following publication of the 2003 edition of *Health Statistics from the Americas*. (See http://www.ingentaconnect.com/content/paho/paho591). Data are presented for the following age groups: all ages, under 1 year, 1-4 years, 5-14, 15-24, 25-44, 45-64, 65 years and over, and age unknown. Estimated and adjusted rates are shown per 100,000 population as well as the male:female sex ratio. (See the section on the estimation of annual mortality rates for the methodology utilized). The male:female sex ratio is defined as the estimated number of deaths in males per 100,000 population divided by the estimated number of deaths in females per 100,000 population. If there is no effect of sex on death from a particular cause, the ratio will have a value

of 1.0. If the value is over 1.0, the ratio expresses the "excess" risk of males dying relative to females from the specified cause, and values less than 1.0 indicate excess female mortality.

A few countries provide mortality data by sex for three categories: male, female, and sex unknown. Deaths, for which the sex is unknown, although not shown separately, are included in the totals.

The information contained in Chapter VI contains selected demographic indicators -- mid-year population estimates by age and sex, percent population change, crude birth rates, fertility rates, infant mortality rates and life expectancy -- from the *World Population Prospects: the 2004 Revision*, prepared by the Population Division of the United Nations.

The Annex Tables contain nine tables. Table 1 shows the status of death registries around 2000 in countries of the Americas. Table 2 shows the percentage of registered deaths assigned to symptoms, signs, and ill-defined conditions around 1985 and 2000 (See the section on quality of mortality data). Tables 3, 4, 5, and 6 are reference tables showing the detail cause distributions of the A9 List, the M9 List, the PAHO 6/61 and PAHO 6/67 Lists, respectively; and Table 7, shows the availability of mortality data in PAHO from 1982-2003. Tables 8 and 9 show the cause groupings of the PAHO/WHO ranking list to determine leading causes of death in ICD-9 and ICD-10, respectively.

Completeness of Data

In many countries of the Americas, the coverage of the civil registration system is incomplete, and in some countries the population covered by available mortality data needs to be further clarified. Within countries, the completeness of registration is known to vary according to geographic area and age group. Registration of vital events is less complete in rural areas than in cities and, in general, is worse in areas with poor living conditions. Annex Table 1 shows the estimated under registration of deaths in countries of the Americas around 2000. The estimates are based on a comparison of the crude death rates obtained using registered mortality, as reported to PAHO for the three-year period indicated, and the death rates estimated by using abridged life table central death rates (see section on estimation of average annual death rates), where available, or from death rates

estimated by the Population Division of the United Nations.

Differences among countries in the time period used for calculation of registered death rates reflect differences in the availability of data from countries at the time the table was prepared. Countrywide registered mortality data are not available from Bolivia and only for recent years and with limited coverage from Haiti. The estimates shown in Annex Table 1 provide an indication of the magnitude of the existing under registration problem in the countries. The characteristics of and underlying reasons for under registration of deaths vary greatly among countries and also within each country. As can be seen in the table, there is little or no under registration in Argentina, Belize, Chile, Costa Rica, Ecuador, French Guiana, Guadeloupe, Guatemala, Martinique, Saint Vincent, Trinidad and Tobago, United States, and Venezuela. In these countries, the registered rate for the period shown is identical to, and sometimes greater than, the estimated rate for the quinquennium that contains the period. Under registration is low in Canada (1.2%), Uruguay (2.6%), Cuba (3.2%), Barbados (5.1%), Puerto Rico (9 %), Mexico (9.7%) and intermediate in the Brazil, Panama, and St. Lucia, which have estimated under registration ranging between 11% and 18%, and appear to be on the way to achieving satisfactory levels of death registration. Another 12 countries continue to have serious under registration problems, with estimates ranging between 22% and 90%. No data from civil registration sources are available for Bolivia. Under registration is greater for infant deaths than for deaths occurring at older ages. Infants who live just a few hours or days may not be registered as either live births or infant deaths. At advanced ages there tends to be overstatement of age, which contributes to under estimation of mortality for some adult age groups and over estimation for older groups. Clustering of deaths in certain ages due to reporting preferences (such as ages ending in 0 or 5) is another well-known phenomenon that affects the age distribution of registered deaths.

Quality of Mortality Data and the Category "Symptoms, Signs, and Il-defined Conditions"

It is well known that statistics derived from registered mortality can be affected during any of the phases in their production: design, collection of data and completion of forms, coding, data processing, and subsequent enumeration. Indicators produced from this information that have

a role in the creation of rates can be altered in both the numerator and the denominator. Therefore, knowledge of the environment in which mortality statistics are produced and the problems that arise when producing them is indispensable for their correct interpretation and use. This knowledge allows for application of procedures to correct problems and improve the quality and credibility of the statistics.

Errors in collecting and processing databases can also give rise to problems that can be apparent only when data comparisons and their trends are studied. This implies a certain degree of knowledge in the field and a regular use of data. Estimation of rates requires a denominator that corresponds to the population by age groups on the one hand and to the registered live births, which are a part of maternal and child mortality rates, on the other hand. The population estimate for inter-census years is taken from projections, which could inadequately calculate migration problems faced by some countries. Live births statistics have some problems, the most important of which is extemporaneous registration of births. Consequently, observed maternal and child mortality rates will differ from actual rates if late registration of births and non-registration of births and deaths are not accounted for.

The quality of cause-specific mortality data is also affected by limitations in current medical knowledge, diagnostic errors, deficiencies of certification, and perhaps to a lesser extent, coding and other processing errors. The validity of the distribution by cause also is affected by under registration of deaths. Cause of death certification, even when done by attending physicians, is often incomplete or of low quality for reasons such as lack of training on proper certification and insufficient understanding of the uses made of the information provided on the death certificate. Another problem frequently encountered is that physicians may prefer certain kinds of diagnoses, such as the ones in their specialty area; this bias may vary from country to country and over time. In many developing countries a sizable segment of the population lacks access to medical care. Consequently, non-attending physicians, who may have insufficient information for a diagnosis, may sign death certificates and non-medical witnesses may provide death reports. Both developing and developed countries face some of the same problems. For example, legal, societal, and other reasons may lead to the underreporting of causes of a sensitive nature, such as suicide or HIV/AIDS, on

the death certificate. Moreover, physicians often do not understand how to adequately fill out the death certificate, especially in relation to the identification of direct, intervening, and underlying causes. Furthermore, the selection of a single underlying cause of death is often problematic in elderly decedents, who often suffer from several chronic diseases that concurrently lead to death.

Clearly, there is a real need to educate the public, physicians, and health sector decision-makers about both the importance of accurate and complete reporting on the death certificate and the impact of erroneous reporting on aggregate mortality statistics. Practices differ from country to country as to whether deaths without medical certification are included or not on tabulations of deaths by cause. A WHO provision specifies that when deaths without medical certification constitute less than 2% of the total, they should be included in such tabulations under the category "ill-defined cause;" when they exceed this percentage, they should be tabulated separately. Countries sometimes apply different criteria, however. Deaths without medical certification are sometimes included in the national cause of death tabulations as follows: under codes 798.9 (ICD-9) or R98 (ICD-10), "unattended death," when the cause of death is not external but is unknown due to the lack of medical care at death or during the illness or condition leading to death; or under codes 799.9 (ICD-9) or R99 (ICD-10), "other unknown and unspecified cause of mortality". For medically certified cause of death data, the simplest indicator of quality is the proportion of deaths assigned to "symptoms, signs, and ill-defined conditions" (SSI), codes 780-799 (ICD-9) and R00-R99 (ICD-10). Where registration coverage is incomplete, however, the proportion of deaths assigned to SSI will usually increase as coverage increases, without there having been a real drop in the quality of medical cause of death certification. In fact, under both ICD-9 and ICD-10, the magnitude of the proportion of deaths assigned to SSI is a lower bound on the proportion of deaths from ill-defined causes, because a number of "defined" ICD-9 and ICD-10 categories, such as, cardiac arrest and heart failure lack diagnostic meaning. It should also be noted that deaths from "defined" causes are not necessarily "well" defined; they are subject to diagnostic, certification, and coding errors that cannot be detected after statistics are compiled. For most countries the proportion of deaths assigned to the category SSI, in combination with the proportion of deaths certified by attending and non-attending physicians, is useful for monitoring

trends and differentials in access to medical care. Annex Table 2 shows, by country, the total number of registered deaths and the percentage of deaths assigned to SSI around 2000 (or the latest 3 data years available) and around 1985. In 21 countries of the Region, less than 5.0 % of registered deaths were assigned to SSI around 2000.

Effect of the change of ICD Revisions on mortality data

The introduction of the Tenth Revision of the ICD in the Americas, starting in 1996, marked the most sweeping changes in the Classification since the Sixth Revision was introduced in 1949 and reflects a conceptual shift in structure and content from previous revisions. Although each revision has produced some breaks in the comparability of cause of death statistics, the change from the Ninth Revision, in use since 1979, to the Tenth Revision has had many consequences on the coding of mortality. The ICD-10 has considerably greater detail than ICD-9 (almost twice the number of codes); and includes shifts of inclusion terms and titles from one category to another, section, or chapter to another; new cause of death titles and corresponding cause of death codes and sections; regroupings of diseases; and changes in the coding rules to select the underlying cause of death. All of these result in a number of discontinuities in the comparability of cause of death statistics over time or in historical series. These discontinuities are best assessed at the national level from the analysis of the results of double-coding (or bridge-coding) studies on national data and observing comparability ratios.

Comparability ratios are derived from the dual classification of the underlying cause of death on mortality records for a single year classified under the new revision and under the previous revision. They are calculated by dividing the number of deaths for a selected cause classified under the new revision by the number of deaths to the most comparable cause classified under the previous revision. A ratio of 1.0 indicates that the same number of deaths was classified to a particular cause or combination of causes regardless of the revision used; it does necessarily mean that the cause was unaffected by changes in classification and coding procedures but that there was no net change. A ratio greater than 1.0 indicates that more deaths were assigned to a cause in ICD-10 than the comparable cause in ICD-9 and a ratio less than 1.0 indicates fewer deaths were

assigned to a cause in ICD-10 than the comparable cause in ICD-9.

The major differences between the Ninth and Tenth Revision are summarized at the end of the Technical Notes section in Table 1, which appeared in a 1996 article in the *Epidemiological Bulletin*[4]. The following paragraphs attempt to address issues in interpreting these differences for selected causes of death.

Changes in the acceptance of causality (sequence) rule, can create differences when comparing ICD-9 and ICD-10. **Pneumonia and bronchopneumonia** can now be accepted as "terminal complications", if they are registered as "due to" or "with mention of " malignant neoplasms, malnutrition, paralyzing diseases, communicable diseases, or serious injuries. This could lead to a decrease in pneumonia and bronchopneumonia deaths and increases in any of the aforementioned disorders. **Chickenpox and herpes zoster** can be accepted as consequences of diabetes mellitus, tuberculosis, or lymphoproliferative neoplasms, with similar consequences. **Malignant neoplasms and infectious and parasitic diseases** can be accepted as a consequence of HIV infection. They can also be accepted as a consequence of immunosuppression by chemotherapy and radiation or of tumors affecting the immune system. **Malignant neoplasm of independent (primary) multiple sites (C-97)** in ICD-10 was coded in ICD-9 to one of the sites specified in C-97. **Secondary malignant neoplasm** in ICD-10 can be coded to existing codes (C77-C79) when there is no information as to the primary site and the site could not be identified from the morphologic type, whereas in ICD-9, this was not acceptable and deaths were coded to "unspecified site" for the morphological type (carcinoma 199.1, sarcoma 171.9, and melanoma 172.9).

The exclusion notes at the beginning of each ICD-10 chapter have been amplified to indicate the relative hierarchy of the chapters. The "special group" chapters have priority of assignment over the organ or system chapters. Among the special group chapters, Pregnancy, childbirth and the puerperium (O00-O99) and certain conditions originating in the perinatal period

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[4] Pan American Health Organization. Revisions of the International Classification of Diseases (ICD-9 and ICD-10): Impact on Health Statistics. *Epidemiological Bulletin* 1996; 17(2): 1-5.

(P00-P96) have priority over the others. More deaths are likely to be attributed to the chapter of **Pregnancy, childbirth and the puerperium (O00-O99)** as a consequence of a rule change in ICD-10. In 1990, the World Health Assembly adopted a recommendation that countries consider the inclusion on death certificates of questions about current pregnancy and pregnancy within one year of death in order to improve the quality of maternal mortality data. As in ICD-9, maternal deaths are defined as the death of a pregnant woman while pregnant or within 42 days of termination of pregnancy, irrespective of the duration and the site of pregnancy, from any cause related to or aggravated by the pregnancy or its management, but not from accidental or incidental causes. That is, deaths occurring more than 42 days after termination of pregnancy and deaths to pregnant women from external causes (homicides, suicides, and unintentional injuries) are not assigned to maternal deaths. If an indirect cause of maternal death, (a death from a previously existing disease or disease developed during pregnancy) is reported on Part I of a death certificate and pregnancy is reported on Part I or Part II, the death is assigned as a maternal death in ICD-10, but ICD-9 assigns this to a maternal death only if pregnancy was reported on Part I.

In ICD-10, **transport accidents (V01-V99)** have been regrouped by type of injured person (i.e. pedestrian, pedal cyclist, motorcycle rider, car or bus occupant) and mode of transport. In ICD-9, transport accidents were grouped according to the type of vehicle involved in the accident. In the case of classifying deaths to **motor vehicle accidents** in ICD-10, the death must clearly indicate that a "motor" vehicle was involved, whereas in ICD-9, the term "motor" did not have to be specified. Accidents involving unspecified vehicles in ICD-10 are classified to "Other land transport accidents". Motor vehicle deaths are classified to motor vehicle traffic accidents if the deaths occurred on a public highway or road, and to non-traffic accidents if they occurred entirely in any other place than a public highway.

Definition of Cause of Death Groups Used

Chapter II and Chapter III present ICD-9 coded mortality tabulated according to the PAHO 6/61 List which was conceptualized in 1987 and first used in the 1992 edition of *Health Statistics from the Americas*. Chapter IV and Chapter V present mortality data tabulated according to the PAHO 6/67 List for ICD-10. These two tabulation

lists were constructed by PAHO in consultation with selected experts in the Region. Their purpose was to facilitate an international overview of mortality statistics, and their development was based on a combination of several public health criteria. The lists consist of six broad groups of causes. The 6/61 List encompasses 61 detailed groups while the 6/67 has 67. These Lists are shown in Annex Tables 4 and 5, respectively. As in previous editions of this publication, deaths due to SSI are presented in a separate category that precedes the cause groups of these Lists.

The PAHO 6/61 List was defined for ICD-9 coded cause of death data which took into account the restrictions imposed by the PAHO mortality Form A used for collecting ICD-9 data. Although most countries no longer use Form A for transmission of data, the PAHO ICD-9 mortality database is still built around cause of-death groups at the level of aggregation given in that form. These cause groups are defined in the A9 List (WHO/PAHO, Form A, 1980), shown in Annex Table 3. The PAHO 6/67 List was designed for ICD-10 coded cause of death data, and was intended, as was the 6/61 List, to provide a panoramic view of mortality in any country. The 6/67 List was constructed to be as similar as possible to the groupings of the 6/61 List. The 6/67 List retained the six broad cause groups of the 6/61 List; however, an exact line for line equivalence of detail groups within the six broad cause groups was not always possible, nor required, due to differences in the ICD Revisions. In defining the 6/67 List, it was assumed that data would be provided to PAHO by countries at the 4-digit level of the ICD and, therefore, no restrictions on the ICD codes making up the cause groupings. A detailed comparison of the cause categories of the PAHO 6/61 List versus the PAHO 6/67 List was published in the *Epidemiological Bulletin* [5]

Countries with a relatively small number of annual deaths are presented in Chapter III and Chapter V and the detail shown there is limited to the six broad groups of each List, which are defined as follows:

Group 1, "*Communicable diseases*," comprises all infectious and parasitic diseases, that is, all the categories in Chapter I of ICD-9 and 10 and additionally, meningitis, acute respiratory

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[5] Pan American Health Organization. New PAHO List 6/67 for Tabulation of ICD-10 Mortality Data. *Epidemiological Bulletin* 1999; 20(3): 4-8.

infections, and pneumonia and influenza. It should be noted that deaths due to AIDS are included in Group 1 of the 6/67 List for ICD-10 (codes B20-B24) but not in the 6/61 List for ICD-9. Although a few countries reported AIDS deaths using ICD-9 codes 042-044, most countries of the Americas follow a WHO Expert Group recommendation that uses ICD-9 codes 279.5 and 279.6 for this disease. Consequently, the PAHO mortality database for ICD-9 assigns all AIDS deaths to the A9 category 18.9, a residual category that includes subcategories of code 279. Therefore, AIDS deaths are tabulated into group 6.14, *Residual of all other diseases* in the 6/61 List.

Group 2, "*Neoplasms*," contains all categories of Chapter II in ICD-9 and ICD-10: malignant neoplasms as well as benign neoplasms, carcinoma in situ, neoplasms of uncertain behavior, and those of unspecified nature.

Group 3, "*Diseases of circulatory system*," contains all categories in ICD-9 Chapter VII: acute rheumatic fever, chronic rheumatic heart disease, hypertensive disease, ischemic heart disease, diseases of pulmonary circulation and other forms of heart disease, cerebrovascular disease, and "other" diseases of the circulatory system. For the 6/67 List, Group 3, contains all categories of ICD-10 Chapter IX.

Group 4, "*Certain conditions originating in the perinatal period*," comprises all categories in ICD-9, Chapter XV and all categories in ICD-10, Chapter XVI: maternal conditions and obstetric complications affecting the fetus or newborn, slow fetal growth, fetal malnutrition and immaturity, birth trauma, hypoxia, asphyxia, other respiratory conditions of fetus or newborn, infections specific to the perinatal period, and other and ill-defined conditions or disorders originating in the perinatal period.

Group 5, "*External causes*," comprises all of ICD-9 Chapter XVII, Code E that is, all accidents, suicide, homicide, injury due to legal intervention and operations of war, and injury undetermined whether accidentally or purposely inflicted. For ICD-10, Group 5 contains all categories of Chapter XX (V01-Y89) that can be used as a cause of death.

Group 6, "*All other diseases*," comprises all other defined causes not included in Groups 1 through 4 or Group 5 -- external causes**.**

Estimation of Average Annual Death Rates by Cause, Age and Sex

Estimated mortality rates shown in Chapters I, II, and IV are based on an estimation procedure described in the 1992 and 2003 editions of *Health Statistics from the Americas.*

The procedure uses selected registered mortality data available in the PAHO mortality database and tabulated for a selected year(s), causes of death, age groups, and sex, estimates of the central death rates ($_nm_x$) for the corresponding age groups and sex, obtained from life tables for 20 Latin American countries prepared and published by the Latin American and Caribbean Demographic Center (CELADE)[6]; and corresponding annual population estimates by age groups and sex. The registered mortality data is first adjusted for deaths unknown by age and sex. The number of deaths unknown by age were redistributed into known age groups by multiplying the number of deaths for each sex and age group by an adjustment factor, $f_a = D/D_a$, where D is the total number of deaths and D_a is the number of deaths stated by age. A similar adjustment factor was used to redistribute the number of deaths in each age group not stated by sex. The rate calculations make the following assumptions about the registered mortality data:

(a) All registered deaths coded to an external cause were in fact due to an external cause, and that none of the registered deaths coded to other cause categories, including SSI, were really due to external causes. Consequently, all deaths assigned to SSI can be proportionately redistributed among other non-external cause categories, age groups, and sex, under the assumption that the SSI deaths follow the same distribution as that observed among registered deaths from non-external "defined" causes.

(b) An estimate of the total number of deaths that actually occurred in a given year or time period was obtained by applying the corresponding quinquennial central death rates for each age and sex group from the life table to the population estimates and totaling the number of deaths in each age group by

sex. By subtracting the number of registered deaths, an estimate of the number of unregistered deaths was obtained. It was further assumed that the distribution of unregistered deaths into cause categories, by age group and sex, was the same as that among registered deaths. Accordingly, unregistered deaths, including unregistered deaths due to external causes, were redistributed into corresponding cause categories by age and sex in the same proportions as the registered deaths.

(c) Estimated age and sex specific rates were calculated by accumulating the estimated total deaths (registered and unregistered) in a given year or time period, by cause category and dividing by the sum of the corresponding estimated populations. The infant mortality rate was calculated using the estimated number of live births, if available. Otherwise, the estimated population under 1 year of age was used in the denominator.

The estimated number of deaths for a selected age-sex group, d'_i and the country's total estimated deaths, D' annually or for a given time period are defined as,

$$d'_i = m_i p_i \quad and \quad D' = \sum_i d'_i,$$

where m_i is the central death rate in the ith age group and p_i, the corresponding population estimate. The estimated number of unregistered deaths, d'_{iU} in the ith age-sex group is defined as

$$d'_{iU} = d'_i - d_{iR},$$

where d_{iR} is the number of registered deaths in the ith age-sex group. The proportion of unregistered deaths due to external causes for the ith age-sex group, $d''_{i\,ex}$ is

$$d''_{i\,ex} = \left(d_{i\,ex}/d_{i\,R} \right) d'_{i\,U},$$

where d_{iex} is the registered number of deaths due to external causes in the ith age-sex group. Therefore, the estimated total number of deaths due to external causes in the ith age-sex group, d'_{iex} is

$$d'_{iex} = d_{i\,ex} + d''_{iex}.$$

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[6] CELADE. Latin America: Life Tables 1950-2025. *Demographic Bulletin* (Santiago), 2004(July); 74. (For English speaking countries of the Caribbean, Canada, Puerto Rico, and United States, registered rates available from the PAHO database were used.)

The estimated total number of deaths, d'_{ic} , for a selected cause category, *c* and age-sex group *i,* can now be calculated from

$$d'_{ic} = d_{ic} + \left(d_{ic} / d_{iR} - d_{i_{ssi}} - d_{i_{ex}} \right) \left(d_{i_{ssi}} + \left(d'_{iU} - d''_{i_{ex}} \right) \right),$$

where d_{ic} is the registered number of deaths in the ith age-sex group due to cause *c*, and $d_{i\,ssi}$ is the number of deaths in i^{th} age-sex group assigned to SSI. The second expression in the above equation reflects the proportionate redistribution of registered SSI deaths and unregistered deaths due to non-external causes in the ith age-sex group that will be re-assigned to cause category *c*. By accumulating the estimated deaths in each age-sex cause grouping the total estimated number of deaths can be determined.

It should be noted that, in some instances, the number of registered deaths for a given year or time period was greater than the estimate obtained from the life table estimates. In those instances and in countries where life table estimates were not available, the registered mortality data, adjusted for unknown age and sex, was used in estimating rates. In effect, this assumes that there was no under registration present in that year or time period.

Mortality Data Availability and Accessibility

Annex Table 7 shows the country-year units of detailed mortality data available in the computerized database of the Pan American Health Organization from 1982-2003 as of 30 November 2005. The full PAHO mortality database, however, contains mortality data from around 1960 – about 1500 data years. The codes in the table describe the level of detail available, as follows:

- The digits in position 1-2 of the code refer to the ICD revision in effect for that particular year, either 9 or 10.
- The letter A or M in position 3 indicates that the level of cause of death detail available and correspond to the A or M List (See Annex Tables 3 and 4).
- Not all countries adhere to the full A or M List, and, consequently, data for some cause groups may not be available for a given country and year. For example, some country-year units only provide total deaths due to external causes (accidents and violence), although full detail may be available for other cause groups. This type of exceptional reporting is indicated by a code within the

country-year units in the database and is not shown in Annex Table 7. In order to ensure correct interpretation, special processing is required whenever those country-year units are selected.

- The two-digit code occupying positions 4 and 5 represents the age distribution of the data for that year. There is substantial variation among countries in this regard. The maximum level of detail available is: under 1 day, 1-6 days, 7-27 days, 28 days-11 months, 1 year, 2 years, 3 years, 4 years, 5-9 years, successive five-year age groups up to 80-84 years, 85 years and over, and age unknown. This level of detail is represented by age code 01. Currently, there are 57 different age distributions or patterns that have been used by countries over the years.

For example, 9A01 for any country-year means that mortality data are available according to ICD-9 in the cause groups used in Form A, with age distribution 01; while code 10A01 means that data is available according to ICD-10 with age group code 01. Although an intermediate "A" type tabulation list for ICD-10 is being developed to correspond to and provide continuity to causes of the ICD-9 Form A List, ICD-10 coded data is now stored in the database at the same level of detail sent by the country.

As noted previously, most information is available disaggregated by sex, and several countries report mortality for three categories: male, female, and sex unknown.

As the Organization continues its efforts to periodically assess the health situation and analyze trends, especially in subnational areas within countries, the need for more detailed health data is evident. The Organization is responding to these increased data needs by requesting mortality and other health information corresponding to sub-national levels as well as developing a new Regional mortality system that will process, tabulate, disseminate, and facilitate subsequent analyses of these data.

Leading Causes of Death

The special topic presented in this issue is a discussion on the leading causes of death in selected countries of the Americas. Determination of the leading causes of death is an informative and popular method to present mortality statistics. It can be a useful indicator and complements more

traditional measures such as crude, cause and age-specific rates, and life expectancy. The rankings reflect the relative cause specific disease burden since the rankings produce the most frequently occurring deaths among a list of causes eligible to be ranked. Therefore, it should be noted that the selection of leading causes is to some extent a somewhat arbitrary process because the rank order of any cause of death is dependent on the list of causes from which it is selected and the rules applied in its selection. Different cause lists and different ranking rules will likely produce different leading causes of death. Populations with younger age distributions will have leading causes that frequently occur among the young, such as homicide, drowning, HIV/AIDS and land transport accidents. Older age distribution populations will have leading causes more prevalent in the elderly such as, Alzheimer's and dementia, heart disease, cerebrovascular disease and malignant neoplasms. In addition, the age groupings used can affect the rankings assigned to any specific age. That is, the leading causes of death for a 25 year old female in the age group 25-34 years of age may be slightly different than those in the age group 25-44 years of age. These differences may have some implications to policy or program interventions.

Recognizing the need to produce a consistent ranking procedure to identify diseases of public health importance, permit international comparisons and is based on a standard list of causes of death, PAHO and WHO collaborated to develop a standardized ranking procedure and causal list. This list was approved by the WHO Family of International Classifications Network Meeting (FIC) in Tokyo, Japan in October 2005 after a review by the WHO/FIC Mortality Reference Group (MRG) and other experts. A full discussion of the criteria and methodology used for developing this ranking list for leading causes of death is described in *A method for deriving leading causes of death*[7]. The PAHO/WHO ranking list for determining leading causes of death in ICD-9 and ICD-10 is shown in Annex Tables 8 and 9, respectively.

The Special Topic section of this publication presents country specific data using this list for ranked causes as well as highlights of the

ten leading causes of death in broad age groups by sex for the latest two or three years of available data. Data are displayed for age groups having at least five deaths. The PAHO/WHO Ranking List contains 65 candidate causal categories, and for completeness a "residual" category containing the remaining non-rankable ICD codes and the category signs, symptoms and ill-defined conditions (R00-R99). Ten cause groupings on the List contain detail sub-categories that can be optionally shown when the broader defined candidate cause is among the leading causes. The sub-categories themselves are not ranked. In the case of tied values, the mean of the corresponding ranks is assigned to the causal categories.

In general, the causal categories of the PAHO/WHO Ranking List were derived from a preliminary version of a ranking list developed by PAHO and from the collaborative examination of the extensive information contained in the WHO Mortality Database, 1994-2004. A number of the cause grouping on the ranking list was determined from an analysis of counts of the most frequently registered three character ICD-10 codes in the WHO database in countries around the world and with different levels of development. Other ranked cause groupings were constructed according to prevention strategies (vaccine-preventable and vector-borne diseases) and to homogeneity in the grouping of cause categories. For some cause categories on the list, such as, heart failure, cardiac arrest, etc., they are often among the leading causes of death and can thus provide an indicator of data quality. The external causes of suicide and homicide are shown as separate categories because the manner in which they are carried out depends upon the means available — using pesticides, painkillers, drugs, firearms, hanging, high places, etc. For non-intentional events involving firearms, falls, land transport accidents (motor vehicles, pedestrians), poisonings, and drowning, the prevention strategies are different and these causes are shown separately as candidate ranking causes.

For external cause groupings that appear as leading causes of death or for detailed analyses of external causes in general, use of the injury matrix developed by the International Collaborative Effort (ICE) on Injury Statistics[8] is recommended. The injury matrix classifies the external cause by its mechanism and intent.

[7] Becker, R., Silvi, J., Ma Fat, D., L'Hours, A., Laurenti, R. A method for deriving leading causes of death. *Bulletin of the World Health Organization* 2006;84:297-304. World Health Organization.

[8] US Centers for Disease Control and Prevention. *Recommended framework for presenting injury mortality data*. MMWR 46 (RR14): 1-30. 1997

Table 1
Comparison between the Ninth and Tenth Revisions of the International Classification of Diseases

Ninth Revision	Tenth Revision
- International Statistical Classification of Diseases, Injuries and Causes of Death	- International Statistical Classification of Diseases and Related Health Problems
- 17 Sections - Two supplementary classifications: (a) External Causes of Injury and Poisoning (E800 - E999) (b) Factors Influencing Health Status and Contact with Health Services (V01 - V82)	- 21 Chapters - Are now in the core classification: (a) Chapter XX, External causes of morbidity and mortality (V01 - Y98) (b) Chapter XXI, Factors influencing health status and contact with health services
- Section III, Endocrine, Nutritional, and Metabolic Diseases, and Immunity Disorders (240 - 279)	- Chapter III, Diseases of the blood and blood-forming organs and certain disorders involving the immune mechanism (D50 - D89)
- Section VI, Diseases of the Nervous System and Sense Organs (320 - 389)	- Chapter VI, Diseases of the nervous system (G00 - G99) - Chapter VII, Diseases of the eye and adnexa (H00 - H59) - Chapter VIII, Diseases of the ear and mastoid process (H60 - H95)

- Classification:
 	
Base: 909 categories
     (183 "X" categories --that is, categories that do not have fourth digit)
 	
5,161 subcategories
 	
Suppl. "E:" 192 categories
          1,001 subcategories
Suppl. "V:" 77 categories
           537 subcategories
 	
Total: 6,882 codes
	- Classification:
	
	2,036 categories (261 "X" categories)
	
	12,159 subcategories
	
	Both are Chapters of the main classification
	
	Total: 12,420 codes

- Groups: 141 - " * ": 4 categories and 67 subcategories dispersed among different categories, with a total of 98 "*" codes."	- Groups: 261 - " * ": 83 complete categories, with a total of 298 codes
- Fifth digit: Tuberculosis: confirmation Diabetes: adult/juvenile Complications of childbirth: method of delivery Musculoskeletal: anatomical site no: subcategory level no: subcategory level Accidents: place of occurrence . not used	- Fifth character: . no category level . not used . no category level anatomical site Fractures: open/closed, internal injuries: with or without open wound no subcategory level Accidents: activity involved
- Some infectious diseases are coded in different sections. 037 Tetanus 634-639 with fourth digit. 0--tetanus complicating abortion 670 Obstetrical tetanus 771.3 Tetanus neonatorum	- Moved to Chapter I (Certain infectious and parasitic diseases) A35 Other tetanus A34 Obstetrical tetanus A33 Tetanus neonatorum
- AIDS is coded in 279.5 and 279.6 (free subcategories of category 279, Disorders involving the immune mechanism)	- Code in B20-B24, under Chapter I (Certain infectious and parasitic diseases)
- Complications affecting specified body systems are coded in 997.-, under section XVII (Injury and poisoning).	- Coded within the chapters corresponding to the body systems. (E89.-, G97.-, H59.-, H95.-, I97.-,J95.-, K01.-, M96.-, and N99.-)
Example: 997.0 Central nervous system complications	G97. - Postprocedural disorders of the nervous system, not elsewhere classified.

Table 2
World Standard Population

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

Source: J Waterhouse et al. (eds) *Cancer incidence in five countries*, Lyon, IARC, 1976 (Vol. 3, p 456).

General Observations

The term "country"as used in this publication, also refers to territories and areas.

Explanation of symbols:

...	Data not available
NA	Category not applicable
0	Magnitude zero
0.0	For rates, magnitude zero when deaths are 0, otherwise, greater than zero but less than 0.05