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□ Editorial

With this issue, a new cycle of the Epidemiological Bulletin (EB) is beginning. To start with, it presents a new image, but keeps the objective of keeping readers informed on the most relevant health events in the Region of the Americas, particularly those related to public health and epidemiology. In this new cycle, the EB will reflect challenges that the Pan American Health Organization (PAHO) faces for the implementation of technical cooperation in three programmatic areas: 1) the unfinished health agenda; 2) the protection of health achievements; 3) the new health challenges.

With regard to the unfinished agenda, there are a variety of unsolved or unconsolidated health situations for which special efforts are required. Among them, emphasis needs to be placed on the reduction of maternal and child mortality rates in countries in the region. This situation is further compounded by deficiencies in information systems or mortality registries that could make it difficult to determine the real dimensions of the problem. This also has led to reliance on the use of estimates and projections which are subject to additional biases and other errors. Furthermore, there are persistent gaps in the control and treatment of some diseases in the region such as AIDS, malaria, tuberculosis, among others. Other pending subjects are achieving the universal access to basic health services as well as the basic and continuous training for human resources in public health and epidemiology.

Concerning the protection of health achievements, a number of very important accomplishments have been met in the Region, but some of them are at risk of being lost if control activities are not kept. Examples are: the immunization program, the oral rehydration salts provision, the eradication of poliomyelitis, the elimination of measles as a public health problem, and the maintenance of surveillance and health information systems. These achievements can be overturned as a result of the lack of research, the presence of natural disasters, population movements, wars and violence, social disruption or new risks and diseases. It is important to foresee how some of these situations would be addressed, for instance, by further focalizing and targeting some financial, material and human resources towards the attainment of the Millennium Development Goals.

Another issue is the one related to new health challenges. The national health sectors and PAHO should be prepared for new or changing health situations, constructing jointly the capacity to anticipate, and plan suitable actions. Therefore, proper and fast responses to emerging diseases and their new global distribution need to be prepared, facing additional requirements for drug supplies. In addition, preparedness for confronting specific consequences of health determinants such as obesity, environmental factors, or poverty, will be required.

These and other subjects on methodologies, norms and standards of epidemiology and other news related to these topics will be addressed in the EB in different sections in this issue and in upcoming issues.

Epidemiologic Situation of Human Rabies in Latin America in 2004

Schneider, M.C.; Belotto, A.; Adé, M. P.; Unidad de Salud Pública Veterinaria, OPS. Leanes, L.F.; Correa, E.; Centro Panamericano de Fiebre Aftosa (PANAFTOSA), OPS. Tamayo, H.; Representación OPS en Perú. Medina, G; Rodrigues, M.J.; Consultores OPS.

Current Epidemiologic Situation

The elimination of human rabies transmitted by dogs in the Region of the Americas by 2005 was a decision made by all Pan American Health Organization (PAHO) Member States in the 1980s.¹ Since then, this mandate has become a regional technical cooperation priority.

The results in the two ensuing decades confirm the enormous effort made by countries. Consequently, analysis of the trend in rabies cases during the period 1982-2003 reveals a decline in the number of human cases from 355 to 35, a 91% drop. This figure reflects the trend of rabies in dogs, which decreased from 15,686 cases to 1,131, equivalent to 93%, in the same period. From 1990 to 2003, dogs were the source of infection in 65% of reported human cases, which fell from 152 to 27 (Figure 1).^A

In 2004, 20 rabies human cases transmitted by dogs were reported in six countries (Figure 2).² Unfortunately, in that same year, cases of human rabies transmitted by other species increased to 71, most of them (46) transmitted by hematophagous bats, in four countries of Latin America (Figure 3). Among them, the epidemic outbreaks of Brazil (22 human cases), Colombia (14), and Peru (8) should be cited.² In 2004, important findings were made: fewer cases of human rabies transmitted by dogs since the start of the Regional Program; a larger number of human cases transmitted by bats; and, for the first time in the history of the Program, cases transmitted by wildlife surpassed cases transmitted by dogs.

According to a PAHO study (2005),³ the areas with the greatest concentration of human cases between 2001 and 2003 were low-income population groups located on the outskirts of large cities such as Port-au-Prince in Haiti, San Salvador in El Salvador, and Fortaleza in Brazil. These areas normally have a high density of stray dogs not reached by vaccination campaigns. Furthermore, the difficult living and working conditions of residents hinder access to treatment for themselves and their children. In 2004, the rabies canine epidemiology in Bolivia had considerably worsened, with outbreaks in La Paz, Cochabamba, and Santa Cruz. The state of Zulia in Venezuela was also worrisome last year.²

Given the current rabies situation in the Region, epidemiologic surveillance is fundamental. In the same study (OPS, 2005),³ an analysis of the frequency of

canine rabies cases in relation to epidemiologic surveillance efforts by second-level geopolitical units (state, department, province) in the 2001-2003 period made it possible to classify the Region into five different epidemiologic areas: 1) no canine cases in the last 10 years; 2) no cases in the last three years, with excellent epidemiologic surveillance (annual samples of 0.1% of the estimated canine population);^B 3) no cases in the last three years, with regular epidemiologic surveillance (annual samples of 0.09% to 0.01%); 4) no cases in the last three years, without epidemiologic surveillance (silent area, samples of less than 0.01% sent); 5) circulation of viral variants 1 and 2 in the canine population.

Areas that have been free of canine rabies for more than 10 years are Panama and Costa Rica in Central America; most of the Southern Cone, including Chile, Uruguay, Argentina, except for the area bordering on Bolivia; and all southern areas of Brazil, including the states of São Paulo and Rio de Janeiro, and some departments of Peru (Figure 4). At the other extreme is an area with active circulation of the rabies virus in canine species, focalized in specific geographic areas like the Bolivia-Argentina and Bolivia-Peru borders, most of Bolivia, north and northeast Brazil, the state of Zulia in Venezuela, areas of El Salvador and Guatemala, and the Guatemala-Mexico border area. Several areas that have had no cases of rabies in the last three years and that have properly functioning epidemiologic surveillance systems will probably be considered free of canine rabies in a few years.³ Some states in Mexico are in the process of being certified as areas free of canine rabies. Few areas at the first geopolitical level are considered silent in Latin America; the majority of these are located in the Andean subregion.

Figure 1. Human Rabies Trend, Latin America, 1982-2004.

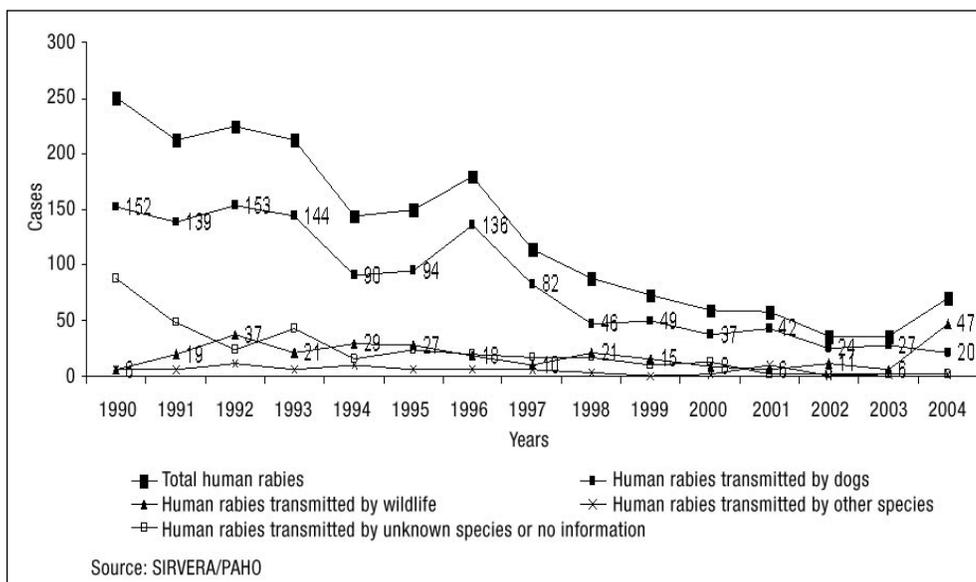


Figure 2. Cases of human rabies transmitted by dogs, Latin America, 2004.



Source: SIRVERA/PAHO.

In 2004, 975 canine cases were reported in 14 countries of the Region, the highest number in Bolivia (355), followed by El Salvador (194), Venezuela (142), and Brazil (104).²

How has this reduction been achieved?

In 1983, the countries of the Region of the Americas, with the support of PAHO, made a commitment to eliminate human rabies transmitted by dogs.¹ Since then, these countries have made major efforts to eliminate this disease, with marked success, within the framework of the Regional Program for the Elimination of Human Rabies Transmitted by Dogs.

The governments of the Region endorsed the political decision to eliminate this disease, allocating nearly US\$ 40 million annually for this purpose. Equally important are the efforts to train personnel to implement rabies control and surveillance measures.

The success reported is due fundamentally to a plan of action based on mass canine rabies vaccination campaigns and on timely prophylactic treatment of the people exposed.⁵ In Latin America, about 44 million dogs are vaccinated every year and approximately 1 million people at risk of contracting the disease are tended to, 25% of them receiving post-exposure treatment. The decentralization of rabies treatment consists of the availability of a health post for every 34,000 inhabitants. For purposes of diagnosis and surveillance, more than 100 national and regional laboratories make up the rabies diagnosis network and process nearly 74,000 canine samples per year.^{3,6}

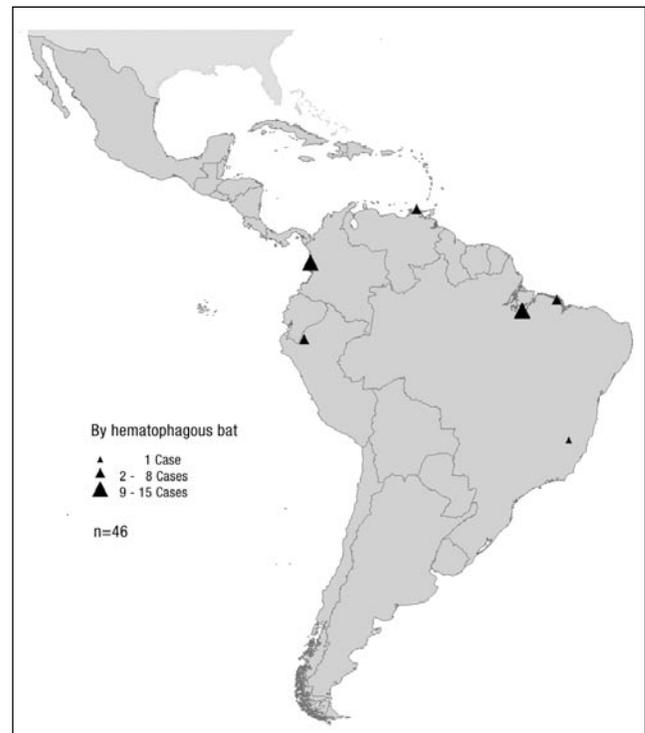
Rabies in the current approach of PAHO technical cooperation

The current rabies situation in the Region, viewed from epidemiologic, economic, and social perspectives, determines the epidemiologic profile of the most vulnerable population groups and is consistent with the underlying premises of PAHO technical cooperation priorities, in which the concepts of unfinished agenda, consolidation of achievements, and facing new challenges are an important part.

In the six countries where canine-transmitted cases of human rabies still occur, it is necessary to work strategically with greater intensity and targeting to achieve the objectives of the unfinished agenda. It is unacceptable that people in Latin America continue to die of rabies transmitted by dogs. As reported in the PAHO (2005) study, in 2003 the 27 cases of human rabies transmitted by dogs in Latin American countries occurred in only 0.2% of second-level units. This suggests that if the countries identify priority areas and intensify and diversify control measures, with provision of human treatment, mass vaccination campaigns, epidemiological surveillance, educational actions, and canine population control, they will likely achieve excellent results.

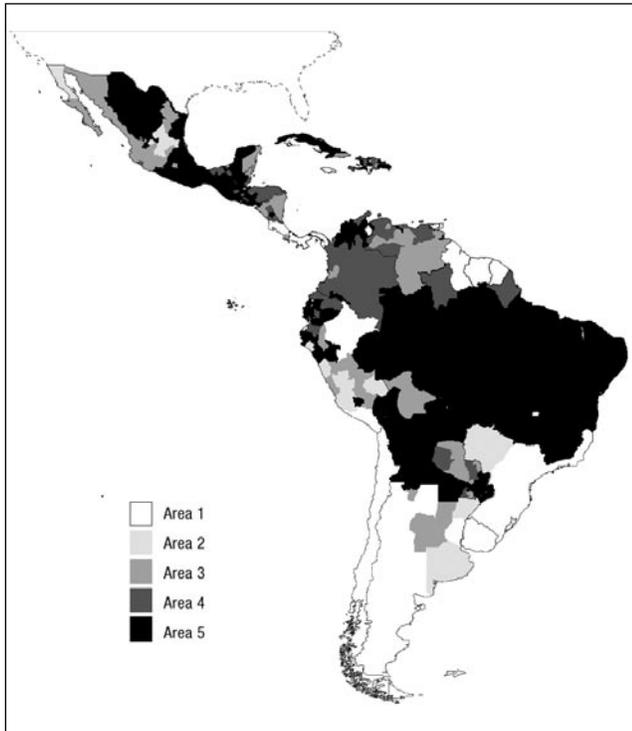
It is important to emphasize that circulation of the rabies virus in the canine population has been eliminated in parts of Latin America. In these areas, the recommended technical cooperation strategy is to consolidate achievements--that is, to ensure the continuity of the political, technical, and budgetary support necessary to execute control measures in outbreaks and epidemiologic surveillance.

Figure 3. Cases of human rabies transmitted by hematophagous bat, Latin America, 2004.



Source: SIRVERA/PAHO.

Figure 4. Epidemiologic situation of canine rabies, Latin America 2001-2003.



Source: PAHO. Elimination of human rabies transmitted by dogs in Latin America. 2005.

Recently, human rabies transmitted by hematophagous bat has become epidemiologically important and can be considered a new challenge. While not a new form of transmission, the number of cases increased in 2004. Human rabies transmitted by bats requires more complex control strategies than those used in rabies transmitted by dogs. In general, the disease occurs in remote areas, often jungle regions where access to health services is difficult.⁷ In order to prevent such outbreaks, joint strategies with other sectors such as agriculture, education, and environment must be sought to define situations of risk and act preventively. Care must be provided for the growing number of people and population groups attacked by bats.

Final comments

Some countries such as Haiti and Bolivia, which currently have the highest number of human and canine rabies cases, are considered key countries requiring priority attention from PAHO.

Since 1983, when the countries of the Region committed to eliminating canine-transmitted human rabies, there have been significant changes, not only in terms of the epidemiologic situation discussed in this study, but of scientific advances. Viral typing tests using monoclonal antibodies are now routinely used in diverse institutions and make it possible to know the species of the transmitting animal. Furthermore, most countries are using cell-culture vaccines to prevent and control rabies, which has reduced the risk associated with suckling-mouse-brain vaccines.

The availability of rabies control strategies validated by decades of use and successful experiences in most countries, in addition to the historical bonds of solidarity forged between countries with the support of the scientific community, are evidence that we can aspire to eliminating rabies soon. The final effort to confront the obstacles identified and sustain the results obtained is the key to eliminating human rabies transmitted by dogs in Latin America. The new challenge is human rabies transmitted by wildlife.

Acknowledgements

Our thanks to the Directors of Rabies programs in the countries of the Region that report regularly to the Regional System for Epidemiological Surveillance of Rabies in the Americas (SIRVERA) and who participated in the study "Elimination of Human Rabies Transmitted by Dogs in Latin America: Situation Analysis."

References

1. Organización Panamericana de la Salud. Estrategia y plan de acción para la eliminación de la rabia humana en América Latina para el final de la década 1980. Guayaquil, 1983.
2. Organización Panamericana de la Salud. Sistema de vigilancia epidemiológica de la rabia en las Américas (SIRVERA), PANAFTOSA, Brasil, 2005.
3. Organización Panamericana de la Salud. Eliminación de la rabia humana transmitida por perro en América Latina: Análisis de la situación. Washington D.C., 2005.
4. Schneider MC. Estudo de avaliação sobre área de risco para a raiva no Brasil. Tesis de Maestría presentada para obtener el título de Mestre em Ciências de la Escola Nacional de Saúde Pública, Fiocruz. Rio de Janeiro, 1990.
5. Belotto A, Leanes LF, Schneider MC, Tamayo H, Correa, E. Overview of rabies in the Americas. *Virus Research* 111:5-12, 2005.
6. Organización Panamericana de la Salud. Informe de la X Reunión de Directores Nacionales de Rabia (REDIPRA). Santo Domingo, República Dominicana, 2004.
7. Schneider MC and Burgoa CS. Algunas consideraciones sobre la rabia humana transmitida por murciélago. *Revista de Salud Publica de México* 37(4), 1995.

A): PAHO through the Pan American Foot-and-Mouth Disease Center (PANAFTOSA) coordinates the Regional Information System for Epidemiological Surveillance of Rabies (SIRVERA), which receives the report of the cases of canine and human rabies that occur in the countries of the Region. This system began in the 1960s and has kept records until today. http://siepi.panaftosa.org.br/wbf_painel.aspx.

B): Criteria based on a study by Schneider (1990) in Brazil⁴ indicating that good epidemiologic surveillance required the submission of a minimum number of samples equivalent to nearly 0.2% of the estimated canine population, or one sample every three months in small areas (4 samples annually). This indicator was revised and it was considered that 0.1% of the estimated canine population is a sufficient number of samples to be submitted.

Methods for measuring health inequalities (Part II)

Maria Cristina Schneider, Carlos Castillo-Salgado, Jorge Bacallao, Enrique Loyola, Oscar J. Mujica, Manuel Vidaurre, and Anne Roca.

Most Common Indicators for Measuring Health Inequalities

Where applicable, depending on the type of indicator, the same example is used to facilitate interpretation and comparison among indicators: infant mortality (IM) in the Andean area, calculated and interpreted according to different methods.

The health variable used in the examples is the infant mortality rate (IMR) per 1,000 live births (LB), obtained from PAHO's basic indicators for 1997.⁶ The other demographic indicators used come from the same source.⁶ The socioeconomic variable was gross national product (GNP) per capita, adjusted for purchasing power parity (PPP), obtained from the World Bank⁷ and also published in PAHO's basic indicators.⁶

Table 1 shows the basic procedures for calculating any of the indicators included in this article on the basis of secondary data.

Rate ratio and rate difference

Two groups in extreme situations are compared, for example social class V (or V + IV) and social class I (or I + II), or two geographic units with extreme socioeconomic indicators. However, it is recommended that the groups are not so extreme that the summary measure masks most of the existing health inequalities nor so broad that the summary measure conceals the real extent of the inequities in the population.³

The interpretation is based on the ratio of, or the difference between, the mortality or morbidity rates of the lowest versus the highest socioeconomic group: the higher the value of the ratio or the difference, the greater the inequality. When

percentiles are used, the terms of the ratio or the difference are the lowest and highest quintiles. The most well-known work that has used this indicator is the Black Report,⁹ published in the 1980s, which analyzed mortality data by social class in England and which, together with other later publications that employed the same procedure, gave rise to the methodological debate over how to measure inequalities in health.

Effect index

Some measures of effect, such as rate ratio and rate difference, take into account only inequalities between the two socioeconomic groups being compared, ignoring those that exist between groups excluded from the comparison. The effect index does not have this limitation because it describes the differences between all population groups through the parameters of a regression model in which the dependent variable tends to be a mortality or morbidity rate and the independent variable is generally an indicator of socioeconomic status. If the relationship between these variables is linear, the slope of the regression line is the absolute effect index and is interpreted as the change that occurs in the dependent variable when the independent variable is modified by one unit (for example, a thousand dollars of GNP).

The biggest drawback to this index is the risk of using inappropriate regression models or estimation methods, such as when the relationship is not linear or the groups are of very different size. In the first case, a linear model cannot be applied, and in the second, ordinary least squares cannot be

Table 1. Initial basic steps for calculating the indicators described, with examples.

Basic steps	Example
Have a clear statement of the research question for the study	Are there inequalities in infant mortality among the countries of the Andean area?
Define the study population	Population of the countries of the Andean area
Define the unit of analysis	Country
Have a clear analysis plan	Describe the distribution of infant mortality in the Andean area and analyze its variability, using rate ratio, population attributable risk, and concentration index and curve
Define the variables used, indicating the source and year of the information	The health variable is the infant mortality rate in 1997 and the socioeconomic variable is PPP-adjusted GNP in 1996; demographic data from 1998. All data from the same source ⁶
If the rate or other indicators have not been calculated, obtain the necessary information for calculating them	Number of live births in 1997 and number of deaths of children under 1 in 1997. Obtained from the same source ⁶
Obtain complementary information, if necessary	Total population in 1997 and crude birth rate in 1997, obtained from the same source (6), in order to calculate the number of live births

Note: GNP: gross national product PPP: purchasing power parity.

used as an estimation procedure. To use linear regression it is recommended to confirm, first, that the basic assumptions of the regression are met and, second, that linearity is present.¹⁰ Other models, such as Poisson regression or logistic regression, may be more appropriate.

Rate ratio and rate difference

Examples of questions that can be answered:

- How many more children under 1 year of age die in the poorest country of the Andean area compared to the richest country?
- How many deaths does that figure represent in absolute numbers?

Data needed:

Table 2.

How to calculate:

1. Calculate the infant mortality rate (IMR) in the geographic units under study:

$$\text{IMR} = \frac{\text{No. of deaths of under 1 year of age}}{\text{No. of live births}} \times 1,000$$

For Venezuela, the country with the highest GNP:

$$\text{IMR} = (12,496 / 568,000) \times 1,000 = 22 \text{ per } 1,000 \text{ live births.}$$

For Bolivia, the country with the lowest GNP:

$$\text{IMR} = (14,750 / 250,000) \times 1,000 = 59 \text{ per } 1,000 \text{ live births.}$$

2. Calculate the rate ratio (RR) between the country with the worst economic situation and the country with the best situation:

$$\text{RR} = \frac{\text{IMR of the country with lowest GNP}}{\text{IMR of the country with highest GNP}} = \frac{59}{22} = 2.68$$

Calculate the rate difference (RD) between the country with the worst economic situation and the country with the best situation:

$$\text{DT} = 59 - 22 = 37 \text{ per } 1,000 \text{ live births.}$$

Calculate this difference in absolute numbers, bearing in mind that the number of live births in the country with the worst situation is 250,000:

$$250,000 \times 37 / 1,000 = 250 \times 37 = 9,250$$

Interpretation:

- In the country of the Andean area with the worst socioeconomic status (Bolivia), almost three (2.68) times more children under 1 die than in the country with the best situation (Venezuela).
- The difference between the IMR of these two countries is 37 per 1,000 live births.
- In absolute numbers, this means that in Bolivia there were 9,250 more deaths of children under 1 than would have been expected if the country's situation were equal to that of Venezuela.

Effect index

Examples of questions that can be answered:

- How much does infant mortality vary in relation to per capita GNP in countries of the Andean area?

Data needed:

Table 2

How to calculate:

1. Calculate the IMR for the geographic units
2. Do a regression analysis of the relationship between the health variable (y) and the socioeconomic variable (x).

In our example, the linear regression model is well adjusted (Figure 1). The estimates obtained are reproduced below from the output of the STATA program, version 6.0:

```
. regress tasa pnb
```

Source	SS	df	MS			
Model	864.251871	1	864.251871	Number of obs =	5	
Residual	54.3561347	3	18.1187116	F(1, 3) =	47.70	
Total	918.608006	4	229.652001	Prob > F =	0.0062	
				R-squared =	0.9408	
				Adj R-squared =	0.9211	
				Root MSE =	4.2566	
rate	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]	
GNP	-.0071152	.0010302	-6.906	0.006	-.0103938	-.0038366
_cons	75.68849	5.85062	12.937	0.001	57.06921	94.30777

Similar results can be obtained with other statistical programs or with an Excel spreadsheet, although the latter does not routinely include standard errors or confidence intervals.

Interpretation:

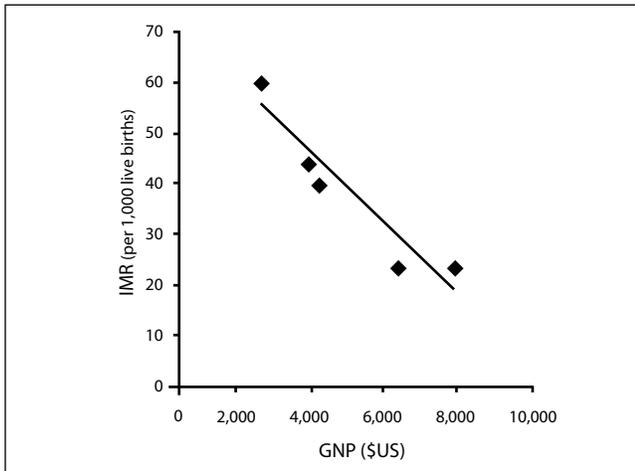
- The slope of the regression line (**b** = -0.007) is equal to the effect index and indicates that, on average, IMR declines by 0.007 deaths per 1,000 live births for each dollar increase in PPP-adjusted GNP, which means that for every thousand dollars of increase in GNP, the average IMR declines 7 units. The sign of the regression coefficient is negative because as GNP increases, IMR falls. The standard error (4.2566) gives an idea of the precision with which IMR can be estimated in relation to GNP.

Table 2. Data needed to calculate rate ratio, rate difference, and effect index. Countries of the Andean area, 1997.

Country	GNP	LB	Deaths	IMR
Venezuela	8,130	568	12,496	22
Colombia	6,720	889	21,336	24
Ecuador	4,730	308	12,012	39
Peru	4,410	621	26,703	43
Bolivia	2,860	250	14,750	59
Total	--	2,636	87,297	33

Note: GNP: gross national product per capita, adjusted for purchasing power parity LB: number of live births (thousands). Deaths: number of deaths of children under 1 year of age IMR: infant mortality rate per 1,000 live births.

Figure 1. Regression line of infant mortality rate (IMR) per 1,000 live births, by gross national product (GNP) per capita, adjusted for the purchasing power parity. Countries of the Andean area, 1997.



Source: Special Program for Health Analysis (SHA), PAHO.

Population attributable risk (PAR)

Population attributable risk is one of the best-known indicators of total impact in the field of health. Also known as the etiologic fraction, it is much used in epidemiology. It is defined as the difference between the general rate and the rate of the highest socioeconomic group, expressed as a percentage of the general rate; the more this diverges from zero, the greater the inequality and the greater potential for reduction of inequality. This makes it possible to estimate the proportion of the general rate of morbidity or mortality that it would be possible to eliminate if all the groups had the same or lower rates of mortality or morbidity as the highest socioeconomic group. In the publication of Kunst and Mackenbach⁵ on socioeconomic inequalities in the field of health, the reference group is the one with the highest socioeconomic status, that does not always coincide with the group with the lowest rate. Depending on the objective of the study, it may be of interest to measure inequality with respect to the lowest observed rate, so that the reference group for calculation of PAR could be the group with the lowest observed value.

PAR can also be calculated through a regression in which the dependent variable (*y*) is mortality or morbidity and the independent variable (*x*) is socioeconomic status. In this case the value used for the rate of the highest socioeconomic group is the value estimated through regression, instead of the observed value of the rate. It is necessary to choose the regression model with the best fit, which normally implies choosing among simple linear regression, logistic regression, and Poisson regression. The latter is especially appropriate for modeling the relationship with rates for very infrequent events.⁵

Using PAR one can also calculate the size of the reduction needed in each group to reach full equality, an indicator that is useful for decision-making bodies because it makes it possible to estimate goals for reduction.

Population attributable risk (PAR)

Examples of questions that can be answered:

- If all the countries of the Andean area had the same infant mortality rate (IMR) as the country with the best socioeconomic status, what percentage of infant mortality (IM) of the countries of the area could be eliminated?
- How many deaths of children could be prevented if all the countries had the same IMR as the richest country?

Data needed:

Table 3.

How to calculate PAR percent:

Simplest method

1. Calculate the IMR for the different geographical units.
2. Calculate the general IMR for the set of geographical units.
3. Calculate the difference between the general IMR and the IMR of the geographical unit with the best situation, divide it by the general IMR, and multiply the result by 100 in order to express it as a percentage:

$$\text{RAP} = \frac{\text{general rate} - \text{rate for the country with the best situation}}{\text{general rate}} = \frac{33 - 22}{33} = \frac{11}{33} = 0.33 \text{ o } 33\%$$

Alternative method

$$\text{RAP} = \frac{p_i (RR_i - 1)}{p_i (RR_i - 1) + 1}$$

Let p_i = population fraction for the group *i* and RR_i = rate ratio for the group *i*. The population fraction is the quotient of the size of the group divided by the total size of the population. For example, the population of live births of Peru (621,000) represents 24% of the total population of live births, which is 2,636,000. In order to calculate the RR the rate for each country is divided by that of the country with the best socioeconomic status. For example, the rate ratio between Ecuador and Venezuela is $39/22 = 1.8$. Thus, we would have:

$$\text{RAP} = \frac{(0.22 \times 0.0) + (0.34 \times 0.09) + (0.12 \times 0.77) + (0.24 \times 0.95) + (0.09 \times 1.68)}{(0.22 \times 0.0) + (0.34 \times 0.09) + (0.12 \times 0.77) + (0.24 \times 0.95) + (0.09 \times 1.68) + 1} = \frac{0.51}{0.51 + 1} = 0.34 \text{ o } 34\%$$

This calculation differs from the previous one only because of rounding, and is, of course, interpreted in an identical way.

Table 3. Data necessary for calculating population attributable risk. Countries of the Andean area, 1997 (reference country: Venezuela).

Country	GNP	LB	RF	Deaths	IMR	RR
Venezuela	8,130	568	0.22	12,496	22	1.00
Colombia	6,720	889	0.34	21,336	24	1.09
Ecuador	4,730	308	0.12	12,012	39	1.77
Peru	4,410	621	0.24	26,703	43	1.95
Bolivia	2,860	250	0.09	14,750	59	2.68
Total	-	2,636	1	87,297	33	-

Nota: **GNP:** gross national product per capita adjusted for purchasing power parity. **LB:** number of live births (thousands). **RF:** relative frequency (LB of the country/LB total). **Deaths:** number of deaths of children under 1 year. **IMR:** infant mortality rate per 1,000 live births. **RR:** rate ratio.

How to calculate Absolute PAR

This can be done in two ways:

1. Multiplying the value of the PAR percent by the general rate for the population:
 $0.33 \times 33 = 10.89$ per 1,000 live births.
2. Subtracting the rate for the reference group from the rate for the total population:
 $33 - 22 = 11$ per 1,000 live births.

Interpretation:^c

- If all the countries of the Andean area had the same IMR as the country with the best socioeconomic status, deaths of children under 1 would be reduced by 33%.
- Of the total of 87,297 deaths taking place in 1997, 28,808 (33% of the total) could have been avoided if all the countries had the same IMR as the country with the best socioeconomic status.

How to calculate PAR using regression

1. Calculate the morbidity or mortality rates for the geographical units.
2. Calculate the general rate for the set of geographical units.
3. Carry out a regression of the health variable (y) on the socioeconomic variable (x), to estimate the value of the rate for the group with the best socioeconomic status. Taking the example used with the effect index ($b = -0.007$; $a = 75.69$):

$$y = a + b x = 75.69 + (-0.007 \times 8,130) = 75.69 - 56.91 = 18.78.$$

4. Apply the PAR formula and multiply the result by 100 in order to express it as a percentage:

$$\text{PAR} = \frac{\text{general rate} - \text{rate for the country with the best situation}}{\text{general rate}} = \frac{33 - 19}{33} = \frac{14}{33} = 0.42 \text{ or } 42\%$$

Interpretation:

- If all the countries of the Andean area had the same IMR as the country with the best socioeconomic status, deaths of children under 1 would be reduced by 42%.

^c Interpretations such as those appearing in this text are only for illustration and should not be taken literally, since this would imply the unrealistic assumption that changes in the health variables are entirely determined by a single socioeconomic indicator.

Table 4. Data necessary for calculating the size of the reduction necessary in each group to reach full equality, using PAR. Countries of the Andean area, 1997 (reference country: Venezuela).

Country	GNP	LB	Deaths	IMR	Reductions in Deaths	
					No.	%
Venezuela	8,130	568	12,496	22	Reference	Reference
Colombia	6,720	889	21,336	24	1,778	8.3
Ecuador	4,730	308	12,012	39	5,236	43.6
Peru	4,410	621	26,703	43	13,041	48.8
Bolivia	2,860	250	14,750	59	9,250	62.7
Total	-	2,636	87,297	33	29,305	33.0

Note: **GNP:** gross national product per capita adjusted for purchasing power parity. **LB:** number of live births (thousands). **Deaths:** number of deaths of children under 1 year of age. **IMR:** infant mortality rate per 1,000 live births.

How to calculate the size of the reduction necessary in each group to reach full equality

1. For each country, take the rate of the country with the best socioeconomic status (Venezuela: 22 per 1,000 live births) and multiply it by the size of the country's own population (in the case of Bolivia: 250,000):

$$250,000 \times 22 / 1,000 = 250 \times 22 = 5,500$$

2. Subtract this value from the total deaths observed in the country (in the case of Bolivia: 14,750) to find the excess deaths for the group.

$$14,750 - 5,500 = 9,250$$

(62.7% of the 14,750 deaths registered in Bolivia).

3. This percentage can also be obtained by applying the PAR formula, taking the rate for the country being analyzed (in this case, Bolivia) as the general rate:

$$\text{PAR} = \frac{\text{general rate} - \text{rate of the country with the best situation}}{\text{general rate}} = \frac{59 - 22}{59} = 0.627 \text{ or } 62.7\%$$

The results obtained for each country of the Andean area are shown in Table 4.

It is also possible to estimate a reduction in the geographical unit considered the reference group for the study if another reference group is selected that does not belong to the group of countries included in the analysis and that has better values for the socioeconomic indicator and for the IMR than Venezuela, for example, Argentina, with a GNP of 9,530 and an IMR of 21 per 1,000. In this case, the estimated reduction for Venezuela would be:

$$\text{PAR} = (22 - 21) / 22 = 0.05 \text{ or } 5\%$$

Given that in absolute numbers 12,496 children under 1 year died in Venezuela, 625 deaths could be prevented ($12,496 \times 0.05$) if Venezuela had the same IMR as Argentina.

Index of dissimilarity

This index can be interpreted as the percentage of all cases that would have to be redistributed in order to have the same rate for the indicator in all the socioeconomic groups. In other words, it expresses the extent to which the distribution of the health event studied in the population approximates the situation in which everyone has the same socioeconomic level.⁵ The index of dissimilarity is large when a large part of the population are in low and high socioeconomic groups and there are few people in intermediate groups.⁵

This indicator can be applied to variables related to health services, such as the number of physicians that would be necessary to redistribute among municipalities to achieve equity. Its application is doubtful for analyzing inequalities in mortality, morbidity, or other indicators of health status because speaking about redistributing deaths or disease does not make practical and ethical sense. For this reason, in this case we do not use the example of IM.

Index of dissimilarity

Examples of questions that can be answered:

- What number of physicians would it be necessary to redistribute among the countries of the Andean area to produce equal rates among the countries?

Data needed:

Table 5.

How to calculate the index:^D

1. Calculate the general rate for the set of geographical units.
2. Calculate the number of events or cases expected in a situation of equality, presuming that all socioeconomic groups have the same value for the health indicator as the population as a whole.
3. Calculate the difference between the number observed and the number expected for the case of equality.
4. Calculate half of the sum of the absolute values of the differences, using the formula:

$$\frac{1}{2} \sum_{i=1}^n |\text{Cases observed}_i - \text{Cases if there were equality}_i| = \frac{51,593}{2} = 25,797$$

Let n be the number of socioeconomic levels and i the rank order of the socioeconomic levels. The formula then gives the absolute index of dissimilarity.

5. Divide the absolute index of dissimilarity by the total number of observations and multiply by 100 to obtain the result in percentage terms (relative index of dissimilarity):

$$\frac{\text{Absolute index of dissimilarity}}{\text{Total number of observed cases}} = \frac{25,797}{134,957} = 0.19 \text{ o } 19\%$$

Interpretation

- For all the countries of the Andean area to have an equitable distribution of the number of physicians per 10,000 population, it would be necessary to redistribute 25,797 physicians (19% of the total) among the countries.

D Metzger X. Información complementaria en la medición de desigualdades e inequidades sociales en salud. Documento de trabajo. OPS, Washington, D.C., 1999.

Slope index of inequality (SII) and relative index of inequality (RII)

Other measures of total impact in health, including the SII and the RII, can be obtained through regression analysis.

These indices are obtained through a regression analysis of a dependent health variable on an indicator of the cumulative relative position of each group with respect to a socioeconomic

variable, taking into account both the socioeconomic status of the groups and the size of the population. The groups are ordered by decreasing socioeconomic status. Each group is characterized by a value (*ridit*) that corresponds to the average cumulative frequency of the group, ordered with respect to the socioeconomic variable. The morbidity or mortality rate of each country is the dependent variable (y).

The slope of the regression line (b) is estimated by the weighted least squares method and represents the change in mortality when the position of the group changes by one unit, or, in other words, the difference between the end points of the scale with respect to the health variable, since the respective positions of these points (their *ridits*) are 0 and 1 (or 0 and 100%). This slope is known as the SII. If it is negative, the two variables (x and y) vary in opposed directions. That is, when socioeconomic status worsens, mortality increases. Just as in the case of other indices based on linear regression, the relation between the two variables should fulfill the basic assumptions for regression and linearity.

To obtain the relative version of this index (the RII), Mackenbach and Kunst³ suggest first obtaining the quotient of b divided by the estimated value of the health variable (mortality) for the higher socioeconomic status ($x = 1$; the highest point in the *ridit* scale). This value then represents the ratio of the rate of the lower socioeconomic group to that of the highest socioeconomic group. To express the result as a rate ratio 1 is added to this value, giving the modified RII. The greater this value, the greater the difference among the groups.

This index should be used preferably when the criterion for grouping preserves a total order for the full set, so that any individual in group i has a better socioeconomic status than any individual of group j (if $j < i$). When data are grouped by geopolitical units, ordered in relation to a socioeconomic indicator, it is not the case that all individuals in a group that have higher average socioeconomic status are better off than all those in a group with lower average socioeconomic status. In test studies conducted with the SII and RII using aggregate data by geopolitical units, these indicators did not appear very stable.¹ The basic requirements for regression and linearity are, as always, conditions for application of these indices based on regression models.

Table 5. Data necessary for calculating the index of dissimilarity. Countries of the Andean area, 1997.

Country	GNP	Physicians per 10,000 population	Population	No. Physicians (actual)	No. Physicians (in case of equality)	Difference
Venezuela	8,130	24.2	22,777	55,120	29,579	25,541
Colombia	6,720	9.3	37,068	34,473	48,138	13,664
Ecuador	4,730	13.2	11,937	15,757	15,502	255
Peru	4,410	10.3	24,367	25,098	31,644	6,546
Bolivia	2,860	5.8	7,774	4,509	10,096	5,587
Total	-	13.0	103,923	134,957	134,957	51,593

Nota: GNP: gross national product per capita adjusted for purchasing power parity. Population: total population of the country (thousands).

Slope index of inequality and relative index of inequality

Examples of questions that can be answered:

- What is the difference between the IMR of the country of the Andean area in the best socioeconomic position and the country in the worst situation?

Data needed:

Table 6.

How to calculate the indices:

1. Obtain the values of the cumulative relative position of the population ordered by the socioeconomic variable (table 6).
2. Make a graph of the two variables to confirm the linearity of the relationship between the health variable and the cumulative relative position of the population ordered by the socioeconomic variable (figure 2).
3. If linearity is confirmed, estimate the slope **b** through a weighted least squares regression. The following estimates were obtained using the STATA program, version 6.0, the results of which are reproduced below.

```
. regress tasa GNP
(sum of wgt is 2.6360e+003)
```

Source	SS	df	MS	Number of obs	=	5
Model	639.05192	1	639.05192	F(1, 3)	=	21.98
Residual	87.2166275	3	29.0722092	Prob F	=	0.0183
Total	726.268547	4	181.567137	R-squared	=	0.8799
				Adj R-squared	=	0.8399
				Root MSE	=	5.3919

rate	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]
posi	-40.46351	8.63047	-4.688	0.018	-67.92952 -12.9975
_cons	53.37553	4.948193	10.787	0.002	37.62817 69.12289

The value of **b** (-40.46) corresponds to the SII.

4. Estimate the value of the health variable (*y*) for the geographical unit with the best situation, using for the variable (*x*) the value of the *ridit* of the group:

$$y = a + bx = 53.38 + (-40.46 \times 0.89) = 53.38 - 36.00 = 17.37$$

5. Calculate the RII using the formula:

$$1 + (b/y) = 1 + (40.46/17.97) = 1 + 2.33 = 3.33$$

Interpretation

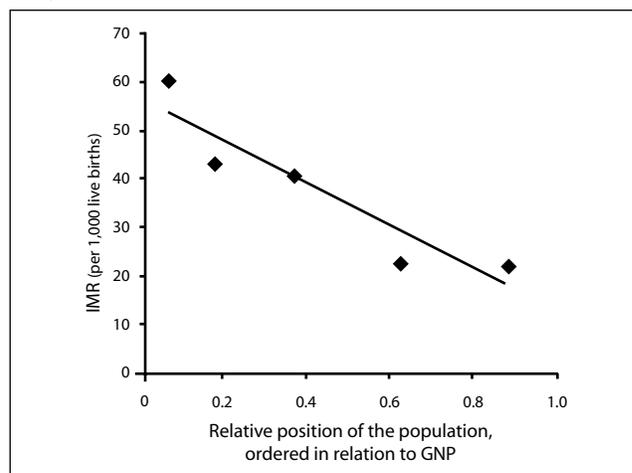
- The absolute difference between the IMR of Venezuela and the IMR of Bolivia is 40.46 deaths per 1,000 live births.
- In relative terms, in Bolivia children under 1 die 3.33 times more frequently than in Venezuela.

Table 6. Data necessary for calculating the slope index of inequality and the relative index of inequality. Countries of the Andean area, 1997.

Country	GNP	IMR	LB	RF	CF (m1)	CF - RF (m2)	Ridit Value [(m1 + m2) / 2]
Venezuela	8,130	22	568	0.22	1	0.78	0.89
Colombia	6,720	24	889	0.34	0.78	0.44	0.61
Ecuador	4,730	39	308	0.12	0.44	0.32	0.38
Peru	4,410	43	621	0.24	0.32	0.09	0.21
Bolivia	2,860	59	250	0.09	0.09	0.00	0.005
Total	-	33	2,636	1	-	-	-

Nota: **GNP:** gross national product per capita adjusted for purchasing power parity. **IMR:** infant mortality rate per 1,000 live births. **LB:** number of live births. **RF:** relative frequency (LB of the country/total LB). **CF:** cumulative frequency. **CF-RF:** cumulative frequency minus relative frequency.

Figure 2. Infant mortality rate (IMR) by cumulative relative position of the population, ordered in relation to per capita gross national product (GNP) adjusted for purchasing power parity. Countries of the Andean area, 1997.



Source: Special Program for Health Analysis (SHA), PAHO.

References (Part II)

1. Greenland S, Morgenstern H. Ecological bias, confounding and effect modification. *Int J Epidemiol* 1989;18:269-274.
2. Mackenbach JP, Kunst AE. Measuring the magnitude of socio-economic inequalities in health: an overview of available measures illustrated with two examples from Europe. *Soc Sci Med* 1997;44:757-771.
3. Kunst AE, Mackenbach JP. Measuring socioeconomic inequalities in health. WHO Regional Office for Europe, 1994 (document EUR/ICP/RPD 416). Se acceso el 12 noviembre 2002 en la siguiente dirección web: <http://www.who.dk/Document/PAE/Measrpd416.pdf>.
4. Organización Panamericana de la Salud, División de Salud y Desarrollo Humano, Programa de Análisis de la Situación de Salud. Situación de salud en las Américas. Indicadores básicos, 1998. Washington, DC: OPS; 1998. (OPS/HDP/HAD/98.01).
5. World Bank. 1998 World Development Indicators. Washington, DC: World Bank; 1998.
6. Organización Panamericana de la Salud, Análisis de la Situación de Salud. Situación de salud en las Américas. Indicadores básicos — Glosario. Washington, DC: OPS; 1998.
7. Townsend P, Davidson N. The Black Report. En: Townsend P, Davidson N, Whitehead M, eds. *Inequalities in health: The Black report and the health divide*. London: Penguin Books; 1988.
8. Daniel WW. *Bioestadística*. México, D.F.: Noruega Limusa; 1991.

The references respect the order of the original article.

Source:

Originally published with the title "Métodos de medición de las desigualdades de salud" in *Pan American Journal of Public Health* 12(6), 2002.

From sketch to digital maps: A Geographic Information System (GIS) Model and Application for malaria control without the use of pesticides

Patricia Najera-Aguilar; Ramon Martinez-Piedra; Manuel Vidaurre-Arenas, Health Analysis and Information Systems (AIS), PAHO.

Introduction

The Geographic Information System (GIS) Model and Application "GIS-DDT" is a technical component of the "Regional program for the action and demonstration of sustainable alternatives on malaria vector control in Mexico and Central America". It is being developed in cooperation with the Areas of Health Analysis and Information Systems (AIS), Sustainable Development and Environmental Health (SDE), and the malaria vector control programs from the participating countries, since 2003. This project has the support of the Global Environment Facility (GEF), the United Nations Environment Program (UNEP) and the North American Commission for Environmental Cooperation (CEC).

The objective of the GIS-DDT model and application is to standardize, integrate, compile and facilitate the interchange of digital cartographic infrastructure (data, methods and software) as a basis for analyzing geographic data about malaria vector control and DDT residuals. The main goal of this component is to contribute to the strengthening of the national technical capacities for malaria control.

GIS Model and Analysis Levels

The GIS-DDT model and application has two levels of analysis: Inter-community and Intra-community; they include the DDT-GEF general project indicators (categorized according to the health system's framework of structure, process and results) that can be spatially analyzed and integrated in the GIS:

Preparation Phase

- Communities selection based on a risk-approach on malaria control model
- 4-6 weeks before the transference phase, local training and data collection
- Head Quarters-Local technical and methodological standardization for geographic data collection

Transference Phase

- In site workshop for adapting the GIS model to local conditions during three or four days
- Identification of lacking data
- Technical and methodological standardization for geographic coding schemes, data collection and analysis

Instrumentation Phase

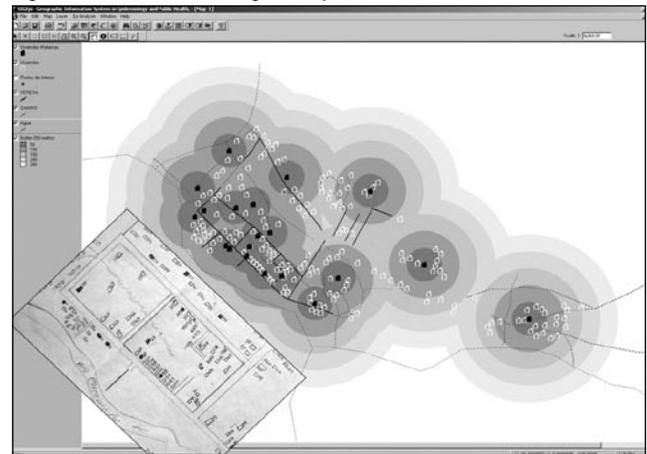
- Prototype development following the GIS model to be used as a platform for data collection, surveillance, analysis and evaluation
- Development from four to eight weeks

Progress

The transference phase has been accomplished in six out of the eight countries: Costa Rica, Guatemala, Nicaragua, El Salvador, Panama and Honduras. They are developing the instrumentation phase. Belize is still in the preparation stage; and Mexico, as complex and large as it is, has designed and developed a web based GIS making an effort to standardize codes and criteria with other countries. Figure 1 illustrates a section of the original sketch map of the Panamanian

community, Bisira, and its digital representation in a GIS map. The GIS map shows cartographic layers of houses with malaria cases, streets, rivers, and concentric buffers that allow the calculation of preventive treatments for dwellings located inside various radiuses, from 50 to 250 meters, around the houses with malaria cases.

Figure 1. From sketch to digital maps.



Preparation Phase Progress

- Belize asked for Global Positioning System (GPS) training and closer follow up in the GIS instrumentation.

Transference Phase Progress

- Workshops developed in six out of the eight countries using GIS and GPS technology is almost complete:
 - Costa Rica, Dec 2004 (reinforcement, May 2005)
 - Guatemala, Feb 2005
 - Nicaragua, Mar 2005
 - El Salvador, Apr 2005
 - Panama, May 2005
 - Honduras, May 2005

Instrumentation Phase Progress

- Most of the countries after the transference phase are developing the geo-referencing process of communities' dwellings, mosquito breeding sites and landmarks, as well as the malaria data bases coding and standardization.
- Mexico has a web-based system.

The cartographic data collection, standardization and integration are in progress in most of the countries. Local health professionals and authorities are still surveying the settlements and mosquito breeding sites in the demonstration areas. Many health workers have expressed their satisfaction and empowerment feelings about having the chance to move forward and changing the way they usually collected and managed their data, from sketch mapping techniques to the use of GPS and GIS.

Maternal and Congenital Syphilis: Case Definitions

Julia Valderrama; PAHO. Marco Antonio Urquia Bautista; Secretary of Health, Honduras. Guillermo Galvan Orlich; Rodrigo Siman Siri; Ministry of Health and Social Welfare, El Salvador. Maria Luz Osimani; Hilda Abreu; Libia Cuevas Messano; Walter Pedreira; Adelina Braselli; Ministry of Public Health, Uruguay. Maria Goretti P. Fonseca Medeiros; Luiza Harunari Matida; Valeria Saraceni; Valdir Pinto; Eduardo C. de Oliveira; Ministry of Health, Brazil. Mary L. Kamb; Centers for Disease Control and Prevention, USA. Angel Almanzar; Ydelsi Hernandez; Ministry of Health, Dominican Republic.

Introduction

Sexually transmitted infections (STI) are among the main causes of disease in the world, with economical, social, and health consequences that have a negative impact in many countries. Their complications affect mainly women and children. In the case of syphilis (caused by *Treponema pallidum*), it can affect the mother, and be further transmitted to the fetus. It is estimated that two thirds of these pregnancies result in congenital syphilis or miscarriage,¹ complications that could be entirely preventable with accessible and low cost technology.

The World Bank World Development Report (1993)² established that the detection and prenatal treatment of syphilis is one of the most cost effective interventions available. Based on several studies and on a theoretical population of Sub-Saharan Africa, in which there were 20,000 annual pregnancies with a positive serological Rapid Plasma Reagin (RPR) prevalence (with a titer greater than 1:8) of 4%, the estimated cost per averted case of congenital syphilis (stillbirth, under weight, and other adverse results of congenital syphilis) would range between 44 and 318 US dollars. The cost for Disability Adjusted Life Years (DALY) would be between 4 and 18.7 US dollars. For comparative purposes, the cost per case of HIV averted in a pregnant woman would be 506 US dollars while the cost for DALY saved would be about 19.2 US dollars.³

Internationally, the ambitious agenda based on the Millennium Development Goals (MDGs) presents a great opportunity to promote the elimination of congenital syphilis. The following MDGs are closely related to the elimination of congenital syphilis: promote equality among genders and autonomy of women (MDG-3), reduce infant mortality (MDG-4), improve maternal health (MDG-5), and combat HIV/AIDS and other diseases (MDG-6).

Background

In 1994, the XXIV Pan American Sanitary Conference called for the development of a regional plan for the elimination of maternal and congenital syphilis as a public health problem in the Americas. The implementation of this plan would require a multi-programatic approach with the participation, at national and local levels, of the following programs: Women and Child Health, Sexual and Reproductive Health, STI/HIV/AIDS, the health services network, and laboratory services.

In 1995, during the 116th Session of the Executive Committee of Pan American Health Organization (PAHO), an Action Plan for the Elimination of Congenital Syphilis was outlined.⁴ Since then, several countries have implemented scattered activities, but no systematic effort involving the region has been adopted. Because of this, in 2003, PAHO reactivated the initiative and the countries' mandate. To address this issue as well as to strengthen regional capacity, the HIV/AIDS Unit at PAHO has

included the elimination of congenital syphilis as part of its 2004-2005 work plan.

The objective of the Elimination of Congenital Syphilis (ECS) as a public health problem, as defined in this Action Plan, was to reduce the incidence of congenital syphilis to less than or equal to 0.5 cases per 1,000 newborns (including stillborn infants). In order to achieve this objective, it would be necessary to detect and treat more than 95% of the infected pregnant women and to reduce the prevalence of syphilis during pregnancy to less than 1.0%.⁴ In 1995, the case definition of congenital syphilis was "each birth product (i.e., stillbirth or live birth) of a woman, with serological evidence of syphilis who was not adequately treated during pregnancy".⁴ Up to now, there are no other parameters to measure the progress toward the ECS and although these have not been verified in the field, it does make sense to direct the interventions and the planning, monitoring, and evaluation activities to pregnant woman rather than toward the newborn.

Currently, 10 years after the 116th Session of the Executive Committee, PAHO continues to use the term "elimination" to provide visibility to the initiative, promote its implementation, and sensitize decision makers and health professionals. Despite this, to ensure the sustainability of the actions, PAHO intends to maintain an integrated approach from the very beginning.

In addition, to emphasize the overlapping with the prevention of mother to child transmission of HIV activities, the phrase, "prevention of mother to child transmission of syphilis," is being used.

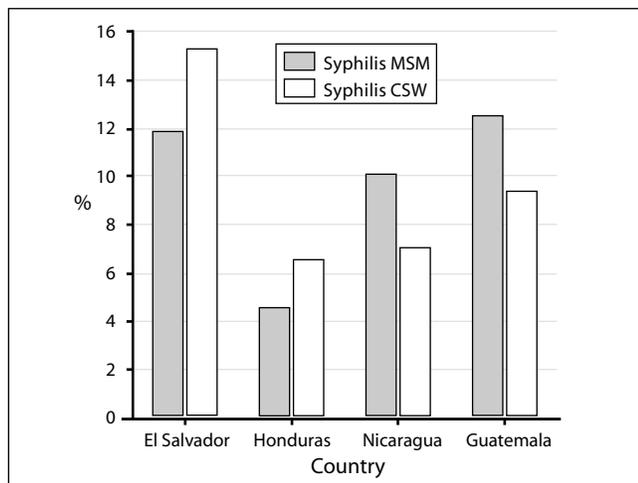
Syphilis in Latin America and the Caribbean

According to WHO estimates in 1999, the number of new cases of syphilis in the world was 12 million. In Latin America and the Caribbean, new cases were estimated to be three million.⁵

In Latin America and the Caribbean (LAC), syphilis affects sexually active people and presents high prevalence within vulnerable groups. In this sense, in Central America the Project Action AIDS of Central America (PASCA, due to its acronyms in Spanish) study (2003) determined syphilis prevalence in men who have sex with men (MSM), which ranged between 5% in Honduras and 13.3% in Guatemala; and in commercial sex workers (CSW) it ranged between 6.8% in Honduras and 15.3% in El Salvador. In South America, in drug users, in Argentina and Uruguay, the prevalence of syphilis was estimated to be between 4.2% and 4.1%, respectively.⁶

In 2003, reports were received from the countries with information on the prevalence of syphilis in pregnant women,

Figure 1. Prevalence of syphilis in men who have sex with men and in commercial sex workers (Multi-center study PASCA, 2002-03).



which fluctuated between 0.4% in Panama and 6.2% in El Salvador.

The incidence of congenital syphilis reported by the countries ranged between 0.0 cases per 1,000 live births in Cuba and 4.0 cases per 1,000 live births in Brazil. The sources of these data are facility-based screening programs, and a field study in the case of Brazil.

In LAC, PAHO estimates 330,000 pregnant women who test positive for syphilis do not receive treatment during their antenatal care visits. Although the stage of the disease is a determining factor, it is estimated that out of these pregnancies, 110,000 children are born with congenital syphilis and a similar number of pregnancies will result in fetal loss¹ (which could also be stillbirth).

Some of the key factors in this region that are identified as contributing to the persistence of congenital syphilis as a major public health problem include: the lack of perception by health care providers that congenital and maternal syphilis lead to severe health consequences, barriers to access antenatal care services, limited demand for syphilis screening tests among health service users, and stigma and discrimination related to sexually transmitted infections, especially syphilis.

Case Definitions:

In May 2004, an experts meeting took place in the Dominican Republic, with a view to preparing the frame of reference for the "Elimination of congenital syphilis in Latin America and the Caribbean." The conclusions of this meeting served as the basis for the development of the document: "Elimination of Congenital Syphilis in Latin America and the Caribbean: Framework for its implementation". Among its contents, the document presents recommendations for surveillance. The case definitions recommended by PAHO for the implementation of congenital syphilis elimination/prevention are the following:

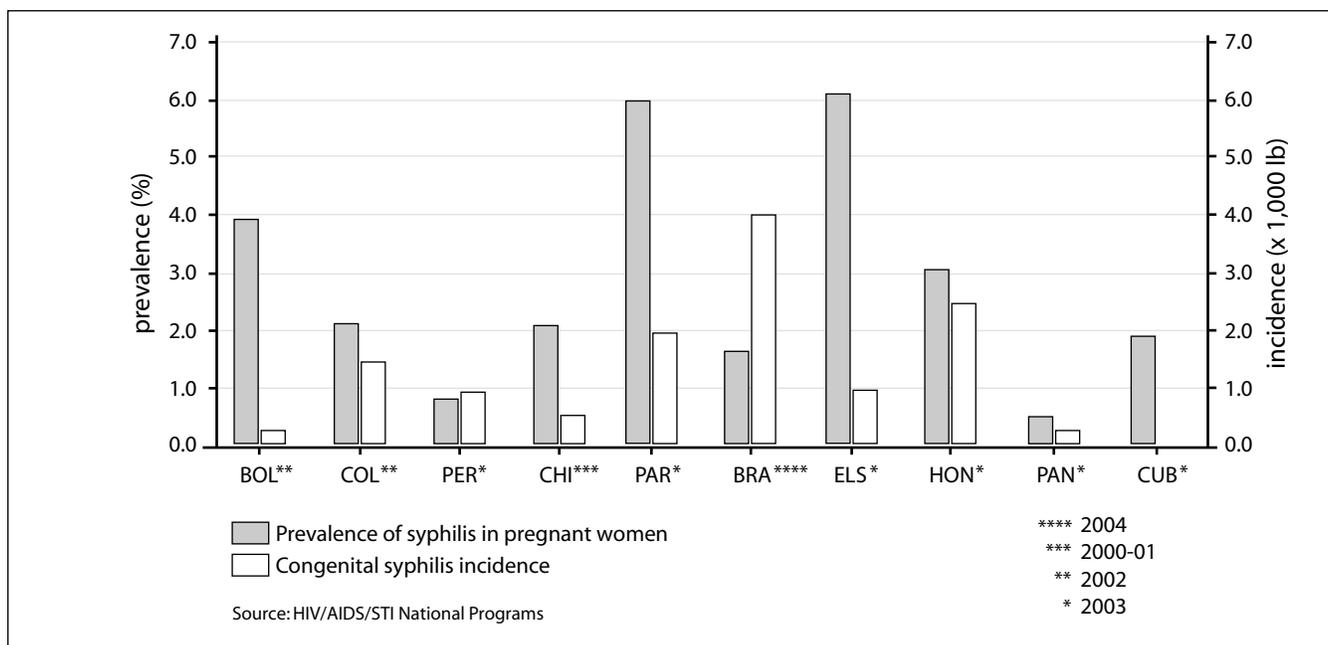
Case definitions recommended by PAHO MATERNAL SYPHILIS

Justification for Surveillance

The fundamental principle of congenital syphilis prevention/elimination consists in detecting and treating the infection in pregnant women in order to prevent mother-to-child transmission of syphilis. All efforts to prevent congenital syphilis should be made at this stage; the detection and the adequate treatment of the pregnant woman should be carried out before the 20th week of pregnancy and at the very least 30 days before delivery.

Furthermore, surveillance helps in identifying the cases

Figure 2. Prevalence of maternal syphilis (%) and incidence of congenital syphilis (x 1,000 lb), in several countries in the region, 2000-2004.



of maternal syphilis and to evaluate barriers that may have caused the failure of prevention activities. Surveillance of sexual contact(s) is very important to avoid re-infection. An inter-programmatic approach for detection, treatment, and surveillance activities is needed.

Recommended Case Definition

"Any pregnant woman regardless of gestation, either puerperal or who has had a recent abortion, who has clinical evidence (genital ulcer or with signs compatible with secondary syphilis) or who has reactive treponemal (including rapid treponemal tests) or nontreponemal tests, and who has not received adequate treatment (carried out before the 20th week of pregnancy and at the very least 30 days before delivery) for syphilis during the current pregnancy."

Clinical description

The first clinical manifestation of syphilis is usually a local lesion at the site of entry. The lesion starts as a dull red macule which rapidly becomes papular and eventually ulcerates. Although primary infections classically present with a painless ulcer (chancre), many primary infections are completely asymptomatic as the chancre may be hidden in the rectum, vagina, cervix, or oropharynx. Local lymph nodes are typically painless, rubbery, non-tender, small to moderate in size, and non-suppurative. Without specific treatment, after four to six weeks the chancre, associated with primary infection, will disappear. At this stage the *T. pallidum*, disseminates throughout the body. Common symptoms in this stage include sore throat, malaise, headache, weight loss, variable fever, and musculo-skeletal pain. In 75% or more of untreated cases, a skin rash will occur.

The classic rash of secondary syphilis begins as a faint, rose-pink macular eruption on the trunk and flexor surfaces of the upper limbs, gradually becoming dull red and macular as it involves the rest of the body. Characteristically, the rash involves the palms of the hands and the soles of the feet and is not itchy or painful. It may also be accompanied by lymphadenopathy. Many variations of the rash of secondary syphilis have been observed, and thus syphilis has been called "the great imitator." Secondary manifestations of syphilis disappear spontaneously with time. Approximately a third of untreated secondary syphilis cases will continue clinically latent for weeks or years. In the first years of its latency, the infectious lesions of the skin and mucous membranes can recur. Syphilis infections can be transmitted to sex partners or unborn children (or occasionally to blood recipients) during the primary and secondary phases.

At any time, the central nervous system or other organs can be affected, for example in the form of acute syphilitic meningoencephalitis in the secondary or early latent syphilis stage; or later in the form of meningovascular syphilis; and finally, in the form of paresis or tabes dorsalis or other manifestations. Occasionally, latent infections persist throughout life.

Laboratory Diagnostic Criteria

The confirmation of the syphilitic infection can only be obtained with two tests, a nontreponemal and a treponemal. However, in order to have a very sensitive case definition, a positive/reactive outcome of any test (treponemal or non-treponemal) can be considered as syphilis.

The most frequently used test in the Region are: a) nontreponemal, Venereal Disease Research Laboratory (VDRL) and rapid plasma reagin (RPR); b) treponemal tests, microhaemagglutination assay for antibodies to *T. pallidum* (MHA-TP), *T. pallidum* haemagglutination assay (TPHA), *T. pallidum* particle agglutination (TP-PA) and the rapid test (diagnostic technique that uses whole blood on strips and is based on the utilization of treponemal proteins as antigens with a reading time of 1-3 minutes).

Epidemiological Criteria

If there is no clinical evidence of infection and no available diagnostic test, a careful risk assessment should be carried out in the pregnant woman, taking into account the vulnerability and the behavior of the couple. Health service providers should be empowered to make decisions on whether to treat pregnant women without clinical or serological evidence of the infection.

Recommended Types of Surveillance

Maternal syphilis should be considered a notifiable disease. Syphilis screening should be recommended as part of routine antenatal care that is integrated into primary health care, and laboratory services.

Syphilis surveillance in pregnant women is based on passive routinely collected data. Ideally, surveillance should cover the entire country and not just the areas of higher prevalence. Maternal and congenital syphilis surveillance should be integrated within the country surveillance system, and especially with the prevention of mother to child transmission of HIV surveillance and programs that promote safe motherhood.

In addition, PAHO recommends maternal syphilis surveillance should be carried out jointly with HIV surveillance. Thus, in areas where sentinel surveillance of HIV in pregnant women is being carried out, syphilis should always be included. Nevertheless, it has to be assessed if the areas with higher prevalence of HIV and syphilis are overlapping.

Minimum Recommended Data

The notification system should include information on:

- Place and date of registration.
- Name, age, and address of the health service user.
- Time of the diagnosis: prenatal (1st, 2nd, 3rd trimester of pregnancy), childbirth, abortion, puerperium.
- Estimated gestational age at time of the diagnosis
- Type of diagnosis performed (laboratory and/or clinical).

Recommended Analysis and Presentation of the Data

Because it is a defined, effective, and measurable intervention, prevention of congenital syphilis represents an opportunity to demonstrate the achievement of the objectives at health units, provinces/departments, and country levels. The number of pregnant women with positive serology for syphilis, by age/month/geographical area should be available.

Maps: At peripheral, intermediate and central levels, information on antenatal care coverage should be available. In order to provide a situational image, it is recommended to elaborate a map with the localities in which the following indicators would appear: estimated prevalence of syphilis in pregnant women, antenatal care coverage, screening and adequate treatment rates.

Figures: a) At the local level, it is recommended to produce a graph that would represent the screening and treatment coverage of pregnant women in the corresponding health area. This will allow visualization of progress toward the goal: 100% pregnant women screened and treated for syphilis. **b)** At local, intermediate, and central levels, it is recommended to produce a comparative graph with data from the previous year by age group and geographical areas.

Main Use of Data for Decision-making

- The health facilities serving a higher syphilis and maternal syphilis prevalence areas should be documented in order to guide prevention interventions for congenital syphilis.
- Monitoring maternal syphilis trends.
- Evaluation of the interventions [screening coverage, adequate treatment of pregnant women with syphilis and her partner(s)].

Special Aspects

Although almost all countries have norms for the screening and treatment of syphilis in pregnant women, they are not applied in a systematic way. As a result, prevalence rates of syphilis in pregnant women estimate the magnitude of the problem, but screening and adequate treatment rates should be considered the basis of the program.

Case definitions recommended by PAHO CONGENITAL SYPHILIS

Justification for Surveillance

The objective of the prevention/elimination of congenital syphilis (CS) is to prevent infections in the fetus and newborn.

The 1995 Action Plan, adopted in the resolution of the XXXVIII Meeting of the Directing Council, specified that CS would be eliminated as a public health problem when incidence rates were equal to or lower than 0.5 per 1,000 births (including stillbirths). Therefore, surveillance is necessary in order to document the achievement of this goal.

Due to the contextual situation of the countries of the Region, it is very difficult to register the stillborns. However, until now there has not been an alternative to accurately find the cases of CS.

Recommended Case Definition

For epidemiological surveillance purposes, the criteria recommended to define a case of congenital syphilis is:

- Any live born infant, stillborn infant, or pregnancy outcome (e.g., spontaneous or other abortion) whose mother has clinical evidence (genital ulcer or lesions compatible with secondary syphilis) or a positive or reactive treponemal test (including rapid treponemal tests) or nontreponemal test during pregnancy, delivery, or puerperium, and who has not been treated or has been treated inadequately.

Or

- Any infant with RPR/VDRL titers fourfold or greater than the mother's titer. This would be equivalent to a change in two dilutions or more from the mother's titers (for example, of 1:4 in the mother to 1:16 in the child).

Or

- Any child with one or more clinical manifestations suggestive of congenital syphilis on either physical or radiographic examination or with a reactive result of a treponemal or nontreponemal test.

Clinical manifestations suggestive of CS: Dystrophias, pneumopathies, snuffles, gastroenteritis, hepatosplenomegaly, osteochondritis of long bones evidenced by radiological examination, mucopurulent rhinitis, pseudoparalysis, jaundice and/or anemia, muco-cutaneous lesions (papules, plaques in perioral region, arms, legs, palms, soles, perianal and perigenital, maculopapular rash in palms and soles).

Or

- Any birth product in which the *T. pallidum* is evidenced by darkfield, immunofluorescence, or other staining or specific procedure, in lesions, placenta, umbilical cord, or autopsy material.

Recommended Types of Surveillance

Congenital syphilis is a notifiable disease in almost all the countries of the Region.

Surveillance of congenital syphilis cases is passive. Routine surveillance of congenital syphilis should be integrated within delivery, obstetrics, neonatology, perinatology, and pediatrics services.

Minimum Recommended Data

The notification system should include information on:

- Place and date of the registry.
- Name, age, and address of the mother.
- Name, age and sex of the congenital syphilis case.
- Diagnostic criteria.
- Clinical data of the CS case: symptomatology, result of the serology (of both mother and child).
- Epidemiological history of the pregnancy: whether syphilis diagnosis was carried out and with which test; if it was adequately treated.

Analysis and Presentation of the Data and Recommended Reports

Maps: In order to provide a situational image, at the intermediate and central levels it is recommended to produce a map with the number of cases, congenital syphilis incidence rate, and syphilis prevalence in pregnant women.

Figures: a) At the intermediate and central level, it is recommended to elaborate a graph in which months/years are specified and where syphilis prevalence in pregnant women and incidence of congenital syphilis can be shown. **b)** At the local (health services), intermediate, it is recommended to produce a graph that would allow comparing information from previous years in different geographical areas.

Main use of data for decision-making

- To determine which are the health facilities that provide delivery care, and where a greater number of congenital syphilis cases are diagnosed.
- To assess congenital syphilis trends to evaluate the effectiveness of preventive activities.
- To monitor the prevention and elimination program.

Special Aspects

- On many occasions congenital syphilis is difficult to diagnose; therefore, studying the mother is very important.

The case definitions recommended by PAHO presented before are very sensitive, and this is needed so that treatment will not be overlooked, since syphilis screening in pregnant women, until now, is not a systematic activity in many antenatal care services.

Most of the countries have established congenital syphilis as notifiable disease. However, this has certain limitations due to the contextual situation in the Region, as it is very difficult for stillbirths or abortions to be notified. On the other hand, there are few countries that have established maternal syphilis as a notifiable disease. The detection of syphilis in pregnant women implies their attendance at antenatal care services and the availability of treponemal (including rapid tests) or nontreponemal (RPR or VDRL test) tests in order to determine their serological status. Registration and notification requires the effort and the will of the professionals in charge. This easy intervention would provide evidence that pregnant women are being screened for syphilis, which is a first step leading to the administration of adequate treatment. Adequate treatment during pregnancy is defined as treatment "provided to the pregnant woman at least 30 days (a month) before delivery (that is, penicillin treatment five weeks before delivery is considered adequate; treatment with penicillin three weeks before delivery is considered inadequate)."

Current emphasis on programs for the prevention of mother to child transmission of HIV should be taken into consideration, because they provide infrastructure and represent an opportunity for the elimination/prevention of congenital syphilis.

In order to support the elimination/prevention of congenital syphilis, PAHO has elaborated two documents:

- Elimination of Congenital Syphilis in Latin America and the Caribbean. Framework for its Implementation

This document is directed to program managers and health professionals of HIV/AIDS/STI programs, providers and planners in the areas of sexual and reproductive health, and maternal and child health. It presents recommendations that allow the implementation of the Regional Program for the Elimination of Congenital Syphilis and the elaboration of national elimination plans. These recommendations can be adopted/adapted according to different contexts. Four strategies for the implementation of the program are presented: attainment of political commitment, development of partnerships and integration with other programs; establishment or strengthening of congenital syphilis surveillance systems, improvement of detection procedures and provision of adequate treatment for maternal and congenital syphilis. The

last part of the document is dedicated to the monitoring and evaluation of the program. The digital version of this document is available on the website:

www.paho.org/Spanish/AD/FCH/AI/EliminaSifilisLAC.pdf

- Methodology for Syphilis Subnotification Studies in Pregnant Women

Among the factors influencing the persistence of congenital syphilis is the notoriously little understanding of the magnitude of the problem due to limitations of the data produced (as underreporting and subnotification). This document aims to support health professionals, at the service and management level, in improving information systems and supporting advocacy activities. The objective of the document is to support underreporting and subnotification studies of maternal syphilis. The digital version of this document is available in the website: www.paho.org/Spanish/AD/FCH/AI/SubnotSifilisEmbarazo.pdf

It is important to promote this initiative and to prevent deaths in children and complications of the syphilis in the fetus. The elimination of congenital syphilis is a measurable and attainable objective with few means and some will. All those professionals of health services, information systems, public health, laboratory, and health managers who work on jointly and with clear objectives will make it possible to ensure the success of this initiative.

References:

1. Pan American Health Organization, HIV/AIDS Unit HIV/AIDS. Congenital syphilis Fact sheet. Washington, D.C., February, 2004. URL: http://www.paho.org/Spanish/AD/FCH/AI/sifilis_cong_hi.pdf. Accessed: May 1, 2004.
2. World Bank. World Development Report 1993: Investing in health. New York: World Bank, 1993.
3. Peeling RW, Mabel D, Fitzgerald DW, Watson-Jones D. Avoiding HIV and dying of syphilis. *The Lancet*. 2004; 365:1561-1563.
4. Pan American Health Organization. Resolution: 116th Meeting of the Executive Comité; XXXVIII Meeting of the Directing Council of WHO for The Americas. Washington, D.C.: OPS; 1995. (Official Document CD38/15).
5. World Health Organization. Global prevalence and incidence of selected curable sexually transmitted diseases: Overview and estimates. Geneva: WHO; 2001. (WHO/CDS/CSR/EDC/2001.10). URL: <http://www.who.int/hiv/pub/sti/pub7/en/>. Accessed: September 10th, 2004.
6. Valderrama J, Zacarías F, Mazin R. Sifilis materna y congénita en América Latina: un problema grave de solución sencilla. *Revista Panamericana de Salud Pública*. 2004;16(3):211-217.

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