Epidemiological Bulletin

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Use of Geographic Information Systems in Epidemiology (GIS-Epi)

Epidemiology in Health Programs

One of the main applications of epidemiology is to facilitate the identification of geographical areas and population groups that present a greater disease or premature death risk and therefore require more preventive or curative care and health promotion. Epidemiology also allows to recognize that the distribution and significance of the factors that lead to the increase of a given risk are not necessarily the same in all population groups. Nevertheless, groups that share similar health risk determinants may also be identified.

Recognition of these groups allows the selection of appropriate social and health interventions in order to reduce or eliminate specific risk factors. These choices often mean that the health services must be reorganized in order to address those unmet needs. Once interventions have been carried out, their impact on health status must be evaluated. The purpose of this evaluation is to determine if it is necessary to make adjusments in the interventions because goals were met or not, or if it is best to continue them until the proposed goals are attained. This dynamic process of diagnosis-action-evaluation-adjustment is part of the methodology known as epidemiological stratification (1).

The current resource constraints and the decentralization process of health services under way in most of the countries demand health programs that are more effective and efficient in their decision-making. For this purpose, health programs require expeditions information systems that allow them to identify the areas or populations with the greatest unmet health needs and to target interventions for those priority groups. With the advent of personal computers and the information and communications highways, efficient health service information systems are now more feasible.

Maps, particularly computerized ones, are valuable in increasing the effectiveness of decision-making. It has been estimated that approximately 80% of the information needs of local government decision-makers and policymakers relate to geographical location (2). In this context, geographical information systems should be considered as one of the existing technologies that facilitate information and decision-making processes in the health services.

What is a Geographic Information System?

A geographic information system (GIS) is a constellation of computer hardware and software that integrates maps and graphics with a database related to a defined geographical space (3). The geographical data may be spatial or descriptive in nature. A GIS can be defined as an integrated set of tools within an automated system capable of collecting, storing, handling, analyzing, and displaying geographically referenced information.

A GIS has several components, each with different functions, including the capability to:

a) Digitize maps, which means that the system captures spatial data for map preparation;

b) Store, handle, and integrate geographically referenced data from different sources, that is, it performs some functions of a database manager system;

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c) Retrieve or locate geographic data, which means that by locating points on a spatial surface, a number of attributes can be determined for that unit in the system;

d) Produce various types of data analyses, including a capability for defining such conditions as adjacency, inclusion, and proximity;

e) Produce output in several formats such as maps, graphs, and tables; and

f) Produce high-quality thematic maps, since different output formats can be employed simultaneously and versatile editing tools are available.

Some software packages—EpiMap (4) and SiMap (5) are two—have some of these capabilities, such as retrieving, storing, and displaying data through maps. However, these packages have limitations with respect to the simultaneous management of different variables or databases, which is to say they correspond more to a mapping system than to a GIS.

A GIS makes it possible to produce different types of analytical maps. One of them is the reference map, which shows the boundaries of certain areas and the location of different objects within them that are usually labeled. An example is a highway map with several types of roads, municipal boundaries, distances, towns, and other features. Due to their conceptual simplicity, superimposing layers of information, reference maps are attractive because they can be easily handled as a set of images. They do not, however, lend themselves to other GIS operations, such as those mentioned below.

Thematic or choropleth maps have areas that are colored or marked in accordance with a key so that the color or marking reflects the intensity of a mapped variable. Examples of these types of maps include, among others: the area map, which shows a phenomenon according to a particular territory; the symbol map, which shows scattered objects in relation to points on the map; the isarithmic o isoline map, which shows phenomena with uniform changes in a pattern of uninterrupted diffusion; the dot-density map, which shows the occurrence of a phenomenon with non-uniform distribution; the cartodiagram in which the size of territorial units represents the magnitude of a phenomenon.

A GIS makes it possible to perform other operations that are valuable in decision analysis and decision-making: redistricting of boundaries, defining of buffer areas or buffering, and determining the distance between objects. In redistricting, the boundaries of one territory can be modified or joined to those of another in order to form a new territory including in these operations the sum of the values of their attributes into a single unit. Buffering allows contiguous or non-contiguous territories or objects of different shapes and dimensions to be selected in order to form a virtual region or area without having to modify boundaries. Both redistricting and buffering capture the information on attributes of an area or region so that they can be managed or analyzed. Distance determination makes it possible to calculate the real distance between two or more points on a map or the area of a territory.

Finally, some GIS packages have the ability to process images such as aerial or satellite photographs, thereby offering continuous and systematic coverage of different types of information within large geographical tracts. Examples include precipitation and frontal systems, vegetation, soil types, and erosion.

Data and Files Required for a GIS and their Sources

There are essentially two types of data used in a geographical information system: cartographic data and descriptive or attribute data. Cartographic data provide a spatial or geographical reference for an object, whereas attribute information indicates the characteristics of the object.

In general, a GIS contains four types of information and computer files: geographic, map, attribute, and data-point files. Geographic files are the heart of a GIS; they contain the data, including the coordinates defining each unit, that are going to be mapped. The map files contain information on the names of geographical files and other related files forming the GIS; e.g., names or labels, coverage, colors, map scale, and lines. Attribute files are rectangular data files whose columns list variables and whose rows correspond to individual cases or geographical points. Finally, data-point files are those produced by linking interfacing attribute files and geographic files through a process called geocoding, using an identifier.

It is commonly believed that cartographic data are available with software packages, and that all that needs to be done is to add the databases with the attributes that are to be analyzed. This is certainly the case in some circumstances, such as those in countries where information development is well advanced and were digitized maps are commercially available at an additional cost. Their cost depends on the level of aggregation required; whether it be, regional, state, municipal, or some other definition like zip codes in the United States or basic geostatistical areas in Mexico.

If such a map is not available, the clear alternative is to prepare a map independently. This can be done through one of three methods: electronic digitizing, data conversion, or the use of global positioning systems (GPS).

Digitizing consists of manually transferring maps in hardcopy to an electronic format. This method requires a digitizing tablet to place points on a map, which are subsequently joined by lines. In contrast to points situated with a mouse, which only supply their relative position on a plane, the absolute position is provided for the point entered with a digitizing tablet, and the defined point will always have the same position of coordinates available, so distances can also be determined. Alternatively, scanners may be employed to reproduce hardcopy maps, although expensive precision equipment is required to transform images to vector formats that can be handled by the GIS. As might be expected, preparation of maps with these procedures requires a considerable time investment, and their quality depends on the accuracy of source maps and the skills of the technician.

Data conversion is done through the selection of control points on maps by their known coordinates for latitude and longitude; the values are then entered for a number of points whose coordinates have been defined through formulas. In this case as well, precision in making calculations and quality of the source maps for the control points are essential.

Finally, the global positioning system (GPS) is used to find a location in the field through radio transmission to satellites, which provide the coordinates for the point of transmission. Each option has a different level of precision and cost, which means the decision on what to use must take account of needs and available resources.

Use of GIS in Epidemiology (Epi-GIS)

GIS use in the field of public health is quite new. The development of these systems gained momentum in other areas such as marketing, transportation, law enforcement, and monitoring geological and climatic phenomena around the world. GIS can be applied in Epidemiology (Epi-GIS), for different aspects most of which are interconnected. Some of the most common uses are the determination of the health situation in an area, generation and analysis of research hypotheses, identification of high-risk health groups, planning and programming of activities, and monitoring and evaluation of interventions.

Epi-GIS can be used to determine patterns or differences in health situations through different levels of aggregation ranging from the hemispheric level, to the regional, national, departmental, district, or local level. For example, basic health indicators are being mapped (6) at the hemispheric level, which has helped to determine which countries have the highest infant mortality rates (Figure 1). Althought there may be many reasons for the infant mortality situation, --lack of drinking water in the home,--on of its causal factors, seems to coincide with higher infant mortality rates (Figure 2). If available resources are limited and a decision must be made about where to use them, it may be suggested at this level that priority be given to water supply systems in places with high infant mortality and low levels of drinking water coverage. Epi-GIS have also been used to map the risk of malaria in Brazil (Figure 3), where it was observed that almost half of the cases occur in a single state containing a small fraction of the population. It was also employed to monitor malaria in Central American and Caribbean countries between 1990 and 1993 (Figure 4), where downward trends were generally observed.

As an analytical tool, Epi-GIS facilitate data uses in ways other than simple projection on a map. For example, the system can calculate the surface of a territorial polygon while the database manager can utilize demographic data sources. In this way, population density estimates were obtained at the municipal level in Guatemala (Figure 5). Due to their considerable variation, the results were grouped and displayed for interpretation to determine the presence of patterns in municipal jurisdictions.

Figure 1. Mortality in countries of the Americas, 1994

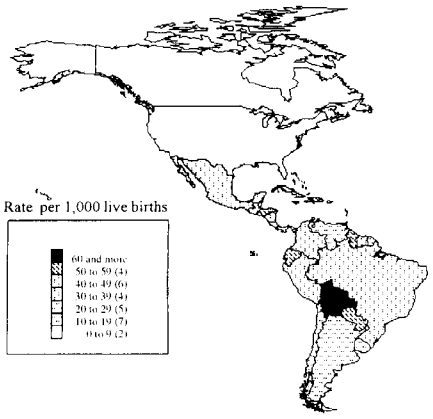


Figure 2. Availability of drinking water in residences in countries of the Americas, 1994

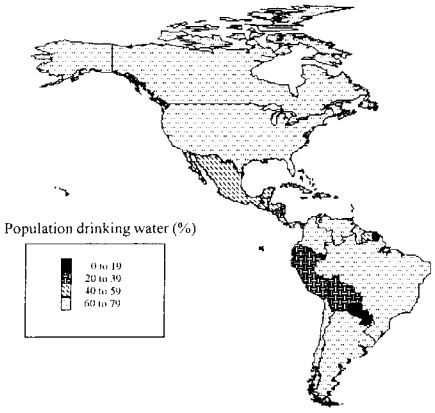


Figure 3. Percentage of malaria cases in the Amazonan states, Brasil, 1992

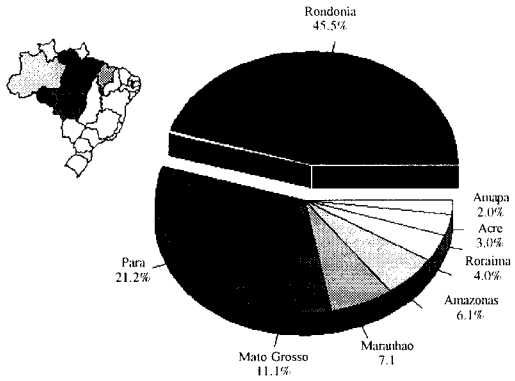
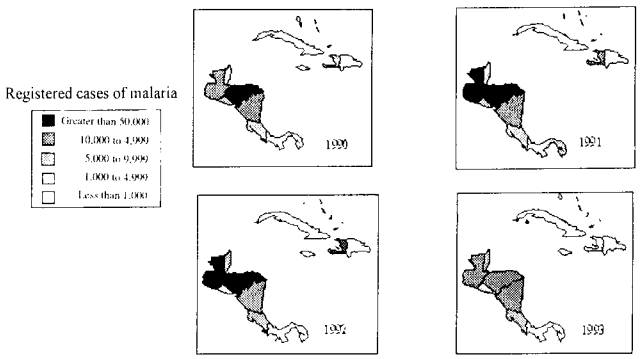


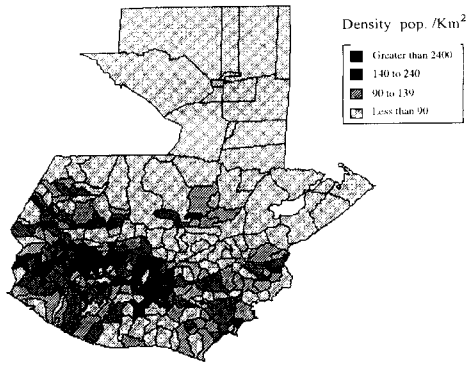
Figure 4. Trends of malaria in Central America and the Caribbean, 1990-1993



Epi-GIS were used for epidemiological surveillance in Cuba during an epidemic of meningococcal disease to determine the municipal areas of the country at greatest risk, to define the absolute magnitude of the problem and the type of disease that was diagnosed most frequently at the provincial level (R. Martinez, R. González, and the PAHO/Epi-GIS Collaborating Center, unpublished). To do this, three different databases were used: one contained individual case data, another consolidated population data, and the third consolidated data for types of care. A complex thematic map was prepared showing mortality at the municipal level with overlays of cartograms indicating the number of cases and the disease profile by province (Figure 6).

As a support for planning, Epi-GIS have been used to evaluate the adequacy of health services to the health care needs for the treatment of severe malaria in the Department of Petén, in northern Guatemala (N. Ceron, H. Altan, Malaria Research Group in Petén and GIS-Epi/PAHO Collaborating Center, unpublished). First, the localities with the greatest risk of severe malaria, caused mainly by *Plasmodium falciparum,* were determined. The next step was to determine if the health facilities were geographically accessible and whether they were distributed according to the needs of the locality. This was done by displaying the roads and buffer areas around the health facilities, which delineate the areas of influence or coverage of the localities within a 12-km radius (Figure 7).

Figure 5. Population density estimates per municipal level in Guatemala, 1994



As can be inferred from the map, it is necessary to adapt health services and provide them to certain widely scattered high-risk localities that are difficult to reach by road, perhaps by using mobile units. Moreover, since it is possible to determine the number of people living in the localities covered by a given health facility, then the size of the population that remains to be served can be calculated accordingly, and the number and type of resources required can also be planned.

Figure 6. Epidemic of meningococcic disease in Cuba, 1993

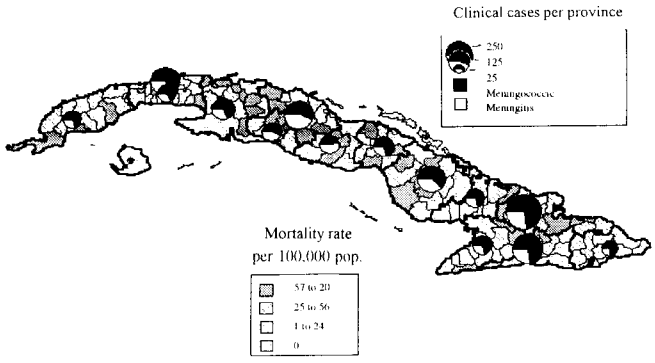
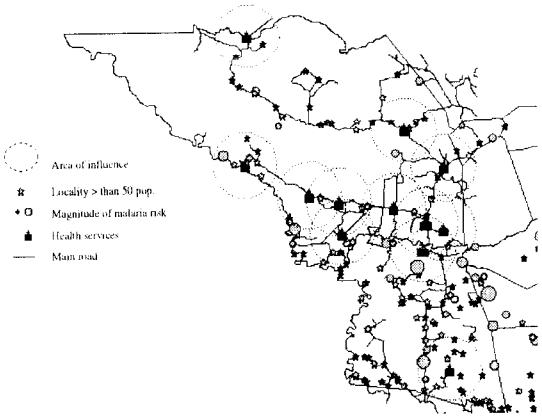


Figure 7. Coverage of health services, access by road and malaria risk per locality in Petén, Guatemala, 1991



According to a bibliographic search on Epi-GIS using the MEDLARS databases for the years 1993-1995, the systems have been utilized in public health in the following ways: 1) identification and characterization of populations that live near high-voltage transmission lines (7); 2) mapping environmental release of toxic chemicals (8); 3) estimates of the risk of fascioliasis (9); 4) monitoring trypanosomiasis in space and time (10); 5) analysis of infant mortality (11; 6) identification of mistakes in road accident records (12); 7) accessibility of hospitals to a population (13); 8) entomological surveillance of vector-borne diseases, such as malaria, dengue, and borreliosis (14-17); 9) factors that affect the non-response to cervical cytology screening (18); and 10) factors associated with child pedestrian injuries (19).

This search indicates that the field has only been explored in a limited fashion, mainly for the diagnosis and the epidemiological surveillance of health problems or risk factors. Most of the work has been performed by professional researchers. However, it is clear that many different possibilities for work in this field remain.

Conclusions and Recommendations

Epi-GIS represent a powerful tool that supports health situation analysis, operations research, and surveillance for the prevention and control health problems. Moreover, these systems provide analytical support for the planning, programming, and evaluation of activities and interventions in the health sector. Thus, GIS can be considered part of the decision-support

systems for people who formulate and follow health policy. GIS represents a new technology in the field of public health, which offers many applications and can strengthen the managerial capacity of health services.

Unfortunately, as with statistical software, GIS are also becoming part of the exclusive domain of specialists in organization rather than being used as a generic tool. Thus, the Health Situation Analysis Program of PAHO's Division of Health and Human Development (HDA/HDP) is encouraging an initiative to develop GIS in the countries of the Region aiming to facilitate access to this tool for information management and analysis. This effort is intended to strengthen another initiative, which is the development and strengthening of epidemiology in the health services. As a part of this development and in order to provide coverage for needs in the Region, institutions have been identified to form a network of reference centers for technical support and training in GIS. The first centers are operating in Chile, Cuba, Guatemala, and Mexico in institutions that represent different academic, research, and health service sectors. It is expected that they will support the training of health professionals in this area, the digitizing of priority geographical areas, the design and implementation of GIS for different needs and resources, and the development of more friendly applications for end-users.

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Source: Division of Health and Human Development, Health Situation Analysis Program, HDP/HDA, PAHO.

Public Health Research Training Grants 1996-1997

In recognition of the importance of developing the public health research capacity of individuals and institutions in Latin America and the Caribbean, the Pan American Health Organization (PAHO/WHO) and the International Development Research Centre (IDRC) of Canada announce the 1996-97 Public Health Research Training Grants.

The initiative proposes to train leaders in public health research by offering them the opportunity to acquire advanced training in this field as well as the possibility to receive additional funding for the implementation of a research project. Given its focus on applied research and on the strengthening of research institutions as well as individuals, the initiative strives to positively impact the decision-making process of countries in the Region, thereby contributing towards the health of their populations.

Selected candidates will receive the following:

- Grant allowing them to spend one year at a leading research/academic institution outside their native country;
- Technical assistance in the development of a research protocol; and
- Possibility of additional funding for the implementation of the research protocol.

The Program

The program is envisioned as having two phases. Although distinct in terms of time and place, these phases actually form part of a continuum, in which the learning process and development of the research project are intertwined.

During the first phase, Fellows will spend 9-12 months at leading teaching/research institutions outside their native countries. Of primary importance during this phase is the development of a research protocol under the supervision of a professor or researcher at the institution of study and with the technical support of PAHO/WHO and IDRC.

During the second phase, Fellows will implement the research project with the support of the home institution. Technical assistance will be provided by PAHO/WHO, IDRC, and the institution of study as a continuation of the learning process begun in phase one. Funding for the second phase is subject to approval of the research protocol by the Review Committee. Monies will be provided for the implementation of the research project and for a visit by the professor/researcher of the institution of study to the project.

Priority will be given to applied research that supports the decision-making process. Priority areas include (but are not limited to) health economics, health systems, and health services. Clinical and bio-medical research are excluded.

The Grant for Phase I is designed to cover round trip airfare, tuition and fees, health insurance, books, and living expenses. The exact amount of the award will depend on the specific needs of each case, taking into account prevailing norms and regulations of PAHO/WHO. In any case, the award is not to exceed US$ 25,000.

By accepting the Grant, the individual agrees to follow the approved plan of study and to return to his or her home institution upon completion of the same.

Selection Process

Candidates will be evaluated on their own qualifications, those of their home institutions, the relevance of their research projects, and their proposed programs of study. All applications must meet the following criteria:

Criteria relative to the candidate:

- Master's degree in any area related to public health research, including the social sciences as applied to health;
- Solid foundation in research;
- Demonstrated capacity for leadership;
- Affiliation with a recognized research institution in his or her country of residence and a research proposal endorsed by it;
- Resident of those Latin American and Caribbean countries participating in the initiative; and
- Proficiency in the language of study.

Criteria relative to the home institution:

- Stable institution with proven research output (either public or private);
- Agreement to carry out the research project, the protocol for which will be developed during Phase I; and

- Plan for institutional development with a specific reference to how the Grant will contribute to that development.

Criteria relative to the institution of study:

- Center of excellence in teaching and research in the chosen area of study;
- Teaching and research programs that favor an interdisciplinary approach, and promote autonomy and flexibility in the development of research projects;
- Interest in maintaining cooperative ties with institutions in Latin America and the Caribbean.

Application Procedure

- Interested candidates should submit the following documents in care of the PAHO/WHO Representative in their country:
- Curriculum vitae and list of publications;
- Research project description to be developed during Phase I and implemented upon return to the home country;
- Letter of support and profile of the home institution (brief description, mission statement, short-and medium-term plans for institutional development);
- Objectives and proposed plan of study for Phase I;
- Acceptance letter from the institution of study for the 1996 academic year, including their agreement to support the development of the research protocol and a cost estimate. Because this is a regional initiative, candidates are requested to provide justification if an institution is chosen from outside the region of the Americas. PAHO/WHO and IDRC will assist in the identification of appropriate institutions and initial contacts, if necessary;
- List of other institutions that have been approached for funding; and
- Proof of proficiency in the language of study.

The research project description should not exceed five pages and should include a description of the problem, a clear definition of the project's objectives, and an approximate description of the methodology to be used.

The deadline for receipt of applications in PAHO Headquarters is 15 May, 1996.

For additional information, please contact the PAHO/WHO Office in your country or:

Public Health Research Training Grants
Pan American Health Organization (PAHO/WHO)
525 23rd Street, N.W., Room 701
Washington, DC 20037
Telephone: (202) 861-3283
Fax: (202) 223-5871

The Sixth Summer Session in Intermediate Epidemiology College of Public Health, University of Southern Florida, Tampa, Florida: **29 July to 16 August, 1996**

The Sixth Summer Session in Intermediate Epidemiology sponsored by the Health Situation Analysis Program, of the *Pan American Health Organization*, will be conducted from 29 July to 16 August, 1996 at the College of Public Health, University of Southern Florida, Tampa, Florida. The courses being offered are: intermediate methods in epidemiology; statistics applied to epidemiology and the use of software packages, and the use of epidemiology in the programming and evaluation of health services. Students are required to have approved basic training in epidemiology. Courses will be conducted in Spanish, but participants must be able to read English.

For more information and application: Carlos Castillo-Salgado, HDP/HDA, Pan American Health Organization, 525 Twenty-third Street, NW, Washington, DC 20037. Tel. (202) 861-3327; Fax (202) 861-5230.

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International Workshop on Population Genetics and Control of Triatominae

Santo Domingo de los Colorados, Ecuador 24-28 September 1995

Chagas disease (american trypanosomiasis) is one of the few vector-borne diseases that can only be controlled by interrupting transmission of the causative agent, *Trypanosoma cruzi*. Transmission by blood transfusion seems to be increasing in many Latin American cities, but most transmission is still due to domestic populations of the insect vectors - large blood-sucking bugs of the subfamily Triatominae. WHO estimates (1) indicate 16-18 million people infected with *T.cruzi*, with around 100 million at risk of infection, making Chagas disease by far the most serious parasitic disease in the Americas (2).

Since 1991, governments of the most seriously affected countries in southern Latin America have been engaged in an ambitious programme to eliminate all domestic populations of the most important vector, *Triatoma infestans*. To date, these governments have invested over US$150 million in vector control activities (3) bringing transmission rates close to zero in many areas (3,4,5). This programma, which is part of the Southern Cone Initiative (6,7), is facilitated by the exclusively domestic habits of *T. infestans* throughout most of its wide distribution. Moreover, *T. infestans* seems highly specialised, adapted to the stable environment offered by human dwellings, with rather low genetic variability facilitating its control by classic house spraying and long-term community-based vigilance.

Outside the southern cone area however, in Mexico, Central America and the Andean Pact countries, there is a range of other vector species of Triatominae, many with widespread silvatic ecotopes. The big question therefore, was to what extent these vectors can also be controlled, leading to a sustainable suppression of Chagas disease transmission throughout Latin America.

Meeting in Santo Domingo de los Colorados, in the foothills of the Ecuadorian Andes, specialists from 15 countries debated during three intense days. The workshop, declared to be 'of National Interest' by the Minister of Health of Ecuador, was primarily sponsored by the Commission of the European Communities. As introduction to be discussions, participants presented detailed reviews of the current epidemiological situation in Mexico, Central America, Colombia, Venezuela, Ecuador and Peru. The first conclusions were quickly apparent: in these countries there are almost 6 million people seropositive for *T. cruzi* infection and around 20-25 million at risk; *Rhodnius prolixus* is the main culprit, accounting for well over half of the reported cases. There are some evidences in Mexico and Central America that at least *R. prolixus* could be exclusively domestic with no reported selvatic foci. If this fundings proves to be true, *R. prolixus* could be a target for complete erradication.

As the debate proceeded on technical and political requirements, a parallel working group discussed research needs to support the vector control and surveillance activities. Basic methods for Chagas vector control are established and well proven. Houses and peridomestic habitats are sprayed with wettable powder or flowable formulations of modern pyrethroids such as deltamethrin, lambdacyhalothrin or cyfluthrin. These are approved for use in domestic situations and quickly produce a dramatic reduction in infestation rates. But treated houses then remain vulnerable to reinfestation. In the long term, this can be addressed by gradually improving the quality of rural housing, rendering it less suitable for triatomine bugs. In the shorter term however, well-organized community-based vigilance is the key to reporting reinfestations so they can be quickly dealt with. But herein lies the second major question.

Reinfestations following control may represent the original vector species, or another. They may represent the original vector population (i.e., hidden survivors recovering from the control treatment) or they may be due to bugs immigrating from untreated foci. Operationally, it becomes important to distinguish between 'survivors' (indicating control failure) and 'immigrants' (indicating poor geographic coverage). Moreover, land-use changes in several regions have been associated with localized domestic invasions by little-known species of Triatominae, providing a certain imperative to identify bug populations that may present a future risk of domiciliation.

Analysis of bug population genetics seems to be providing the means to address these questions, as well as providing a cohesive framework for collaborative research throughout Latin America. Presentations in the

meeting discussed the use of morphology eggshell architecture, head and wing morphometrics, sensilla patterns, isoenzymes, cuticular hydrocarbons, cytogenetics and chromosome analysis, and random amplified polimorfic DNA test (RAPD), as well as the results of complex interfertility studies. Each technique offers deferent practical advantages, but each seems to point in a similar direction. Triatominae seem to represent a genetically heterogeneous group, with generalist species displaying higher genetic variation, and specialist species showing relatively reduced population variability - probable associated with a series of genetic bottlenecks followed by modest selection. Populations tend to show strong geographic structuring, which can be detected, for example, by consistent morphometric, cytogenetic and isoenzyme markers and already there are several outstanding results of operational importance. I n Colombia for example, calculated gene flow between silvatic and domestic populations of *R.prolixus* seems remarkable low giving optimism that control of domestic populations may not abe heavily influenced by silvatic invasions. Similarly in Bolivia, there is increasing evidence of isolation between silvatic and domestic *T.infestans* again giving optimism for unimpeded elimination of domestic populations of this vector. And most importantly, isoenzymes and morphometrics have already provided a means to identify the source populations of reinfestant *T.infestans* following control interventions.

The workshop ended with a feeling of accomplishment, and of optimism, having identified clear operational and technical goals as well as administrative steps toward their implementation. There was a feeling of brotherhood too, of Latin Americans building on collective experience to resolve a uniquely Latin American problem. A summary of the meeting has been presented to the Minister of Health of Ecuador, and the full report will be published early in 1996.

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Source: Division of Disease Prevention and Control, Communicable Diseases Program, HCP/HCT, PAHO.

IV Cuban Congress of Hygiene and Epidemiology
I National Congress of Infectology

The Fourth Cuban Congress of Higyene and Epidemiology will be held in La Habana from 18 to 22 of November 1996. The main objectives of this Congress, is to promote the encounter and the exchange of experience between national and international specialists on the most advanced and recent scientific and technical aspects of Hygiene, Epidemiology, Infectology and related specialities. Other objectives are the analysis of current and prospective health problems in the frame of Cuban strategy to increase the health situation of the population from 1996 to 2000.

The main topics of the Congress, which include symposium and workshops, will be: epidemiology of communicable and non-communicable diseases; clinical epidemiology; social epidemiology; genetic epidemiology; health interventions; health surveillance; nosocomial infections; teaching in hygiene and epidemiology; occupational health; health and tourism; health and reproduction; and workers health.

During November 18 and 19 several pre-congress courses will be offered on: clinical epidemiology; genetic epidemiology; social epidemiology; health and enviroment; surveillance of micronutrient; methods of rapid epidemiological evaluation; risks, population causality and the enviroment; epidemiology and the planning and evaluation of health services.

The deadline for presentation of abstracts is June 15, 1995. For additional information please contact:

Secretariado Permanente del IV Congreso Nacional de Epidemiología; Consejo Nacional de Sociedades Científicas del MINSAP; Calle L No. 406 e/23 y 25, Vedado; Plaza de la Revolución, C.P. No. 10400, La Habana 4 ó Centro de Eventos ORTOP. Fax 9537) 331422 or (537) 336444 ó Telex: 511983 ORTOP CU.

AIDS Surveillance in the Americas

TABLE 1. NUMBER OF REPORTED CASES OF AIDS BY YEAR, AND CUMULATIVE CASES AND DEATHS, BY COUNTRY AND SUBREGION.
As of 10 March, 1996

SUBREGION Country	Number of cases									Date of last report
	Through 1989	1990	1991	1992	1993	1994	1995(a)	Cumulative total(b)	Total deaths	
REGIONAL TOTAL	**181,520**	**65,136**	**78,758**	**100,297**	**101,263**	**85,197**	**54,548**	**669,464**	**392,751**	
LATIN AMERICA	**25,666**	**14,897**	**17,784**	**21,580**	**24,573**	**24,078**	**14,924**	**146,197**	**67,132**	
ANDEAN AREA	**2,600**	**1,619**	**1,818**	**2,148**	**2,036**	**2,387**	**1,483**	**14,862**	**7,032**	
Bolivia	19	11	19	19	20	13	8	109	85	30/Sep/95
Colombia	1,160	773	857	931	732	1,324	764	6,541	2,867	31/Dec/95
Ecuador	96	47	55	69	90	117	69	543	393	31/Dec/95
Peru c)	241	179	206	327	381	415	189	2,709	711	30/Jun/95
Venezuela	1,084	609	681	802	813	518	453	4,960	2,976	30/Sep/95
SOUTHERN CONE	**981**	**721**	**997**	**1,363**	**1,759**	**2,353**	**1,480**	**9,654**	**3,601**	
Argentina	655	481	713	1,044	1,385	1,990	1,149	7,417	2,249	31/Dec/95
Chile c)	211	145	179	201	226	220	181	1,363	836	31/Dec/95
Paraguay	32	19	19	28	45	24	23	190	131	31/Dec/95
Uruguay	83	76	86	90	103	119	127	684	385	31/Dec/95
BRAZIL	**13,938**	**7,553**	**10,049**	**12,398**	**13,640**	**13,110**	**5,708**	**76,396**	**38,392**	02/Dec/95
CENTRAL AMERICAN ISTHMUS	**1,162**	**912**	**938**	**1,222**	**1,609**	**1,746**	**1,558**	**9,224**	**2,738**	
Belize	25	11	10	13	24	18	28	138	130	31/Dec/95
Costa Rica	155	84	92	127	124	155	161	898	499	31/Dec/95
El Salvador	129	54	132	114	176	387	380	1,372	236	31/Dec/95
Guatemala	84	92	96	94	118	110	104	711	242	31/Dec/95
Honduras	563	595	508	751	972	852	703	4,973	955	31/Dec/95
Nicaragua	4	7	13	6	17	37	18 **	126	72	04/Mar/96
Panama	202	69	87	117	178	187	164	1,006	604	31/Dec/95
MEXICO	**3,316**	**2,592**	**3,166**	**3,221**	**5,094**	**4,048**	**4,310**	**27,564**	**14,167**	31/Dec/95
LATIN CARIBBEAN	**3,669**	**1,500**	**816**	**1,228**	**435**	**434**	**385**	**8,497**	**1,202**	
Cuba	44	28	37	70	82	101	78	440	288	31/Dec/95
Dominican Republic c)	1,172	256	287	352	353	333	307	3,090	617	31/Dec/95
Haiti	2,453	1,216	492	806	...	...	...	4,967	297	31/Dec/92
Puerto Rico *	4,611	1,834	2,238	2,250	2,374	673	...	13,980	8,183	30/Sep/94
CARIBBEAN	**1,954**	**754**	**973**	**1,185**	**1,321**	**1,455**	**1,330**	**8,972**	**5,273**	
Anguilla	3	1	1	0	0	0	0	5	3	31/Dec/95
Antigua and Barbuda	5	3	6	13	7	6	5	45	20	31/Dec/95
Aruba c)	6	4	1	3	1	0	5	20	16	31/Dec/95
Bahamas	440	168	230	254	297	322	165	1,876	1,054	30/Jun/95
Barbados	111	61	80	78	88	119	95	632	530	31/Dec/95
Cayman Islands	5	2	4	4	0	3	0	18	16	31/Dec/95
Dominica	10	2	0	0	14	5	...	31	11	30/Jun/94
French Guiana c)	127	46	46	96	58	55	61	489	267	30/Sep/95
Grenada	19	5	7	4	21	7	13	76	53	30/Sep/95
Guadeloupe c)	148	35	51	103	93	110	83	623	226	30/Sep/95
Guyana	84	61	85	160	107	105	96	698	193	30/Jun/95
Jamaica	137	62	134	100	236	359	505	1,533	907	31/Dec/95
Martinique c)	104	46	29	47	34	48	36	344	184	30/Sep/95
Montserrat	3	1	2	0	1	0	0	7	0	31/Dec/95
Netherlands Antilles	47	30	23	10	47	0	76	233	74	31/Dec/95
Saint Kitts and Nevis	24	8	1	4	3	5	2	47	29	30/Jun/95
Saint Lucia	23	4	6	8	12	13	10	76	66	31/Dec/95
St. Vincent and the Grenadines	21	6	14	5	8	8	6	68	69	31/Dec/95
Suriname	57	33	16	28	35	20	20	209	189	30/Jun/95
Trinidad and Tobago	561	173	234	263	243	269	149	1,892	1,332	30/Jun/95
Turks and Caicos Islands	18	1	2	4	14	...	...	39	30	30/Sep/93
Virgin Islands (UK)	1	2	1	1	2	1	3	11	4	31/Dec/95
NORTH AMERICA	**153,900**	**49,485**	**60,001**	**77,532**	**75,369**	**59,664**	**38,294**	**514,295**	**320,346**	
Bermuda	135	33	23	17	15	44	48	315	213	31/Dec/95
Canada	4,542	1,360	1,429	1,607	1,580	1,365	737	12,670	9,133	31/Dec/95
United States of America *	149,223	48,092	58,549	75,908	73,774	58,255	37,509	501,310	311,000	31/Oct/95

* Cumulative total number of cases and deaths for the United States of America includes data from Puerto Rico. Total number of cases and deaths reported by Puerto Rico as of 30/Sep/94 has not been included in the Latin Caribbean totals.
** Includes 9 cases reported during first quarter 1996.
a) 1995 data are incomplete due to delayed reporting.
b) May include cases for year of diagnosis unknown.
c) Revised data.

Introduction of new vaccines in the National Vaccination Programs

The introduction of new or improved vaccines in national vaccination programs should be preceded by a determination of the intervention's priority through analysis of the epidemiological parameters of each country, a clear definition of the strategies and standards for use of the vaccines (vaccination schedule, age groups, number of doses, and vaccination techniques), and considerations related to the resources needed to ensure constant availability of the vaccines in the health services.

Furthermore, when a new vaccine is about to be incorporated in a national vaccination program, this action should be preceded by an intensive mass communications program to inform the population about the vaccine, its use, and the disease that it is going to prevent, since the incorporation of new vaccines in the vaccination programs generally implies additional visits by boys and girls to the health services, and often additional injections, which may lead to resistance among the population.

Briefly described below are examples of some of the vaccines already available for use in special population groups and/or risk areas for certain diseases. These vaccines are being introduced or are under consideration for introduction in countries in Latin America and the Caribbean.

1. Hepatitis B vaccine

Acute viral hepatitis is a serious infectious disease caused by different types of virus (A, B, C, Delta, E) that differ not only in their mode of transmission and their epidemiological, clinical, and immunological characteristics but in the means of their prevention and control.

The hepatitis B virus has been identified as a carcinogenic agent and is estimated to cause nearly 80% of all hepatocellular carcinomas worldwide. The hepatitis B vaccine prevents all forms of transmission of the infection: perinatal, percutaneous, transfusion-related, and sexual.

Two types of vaccines are available: surface antigen of hepatitis B virus (HBsAg), produced from purified human plasma, and another obtained through genetic engineering (recombinant DNA). The two vaccines are safe, immunizing, highly effective (>90%), and produce very few adverse reactions. They are administered intramuscularly, usually in a series of three doses, the first two within at least one month of each other, and the third dose administered 6 to 12 months after the first. The dose varies with the age of the population to be vaccinated: 5-10 mcg (children) and 10-20 mcg (adults).

The vaccination schedule is flexible with regard to the dosage interval; hence, the vaccine can be easily incorporated into the EPI. It should be kept refrigerated at 2-8 °C and should not be frozen. It should be noted that the vaccine is characterized by high thermostability.

The recommended vaccination strategy depends on the prevalence of infection in the populations of the targeted regions and in high-risk groups (e.g. health workers, homosexuals, intravenous drug addicts). The areas of risk are defined as:

- High endemicity: over 8% of the population are carriers
- Intermediate endemicity: from 2% to 8% of carriers
- Low endemicity: less than 2% of carriers

The Technical Advisory Group for the EPI does not recommend universal vaccination of children in the countries of the Region. Its recommendation is that hepatitis B vaccine be considered for use in populations or areas at risk for the disease. Universal vaccination should only be considered if the available resources permit a supply of this vaccine without jeopardizing the supply of the other vaccines routinely being utilized. In addition, surveillance activities should be undertaken in order to improve information on the disease and to measure the impact of the strategies utilized on the incidence of the disease in the short and medium term and on hepatocellular carcinoma in the longer term.

2. MMR Vaccine (Measles, Mumps, Rubella)

MMR is a combination vaccine against measles, mumps, and rubella, made from attenuated live virus.

The vaccine should be kept under refrigeration at 2-8 °C in the health services. For extended storage it should be frozen.

A single deep, subcutaneous dose of 0.5 ml is administered to children from 9 months of age on. The recommended vaccination schedule indicates between 12 and 18 months of age. It is approximately 95% effective.

The fundamental reason for using the vaccine containing the rubella antigen is to prevent congenital rubella syndrome. For adequate control of this syndrome

women of childbearing age should be protected against rubella before pregnancy.

The percentage of infection in the fetuses of mothers infected by rubella during the first trimester of pregnancy is greater than 80%. As a result, the target group for the vaccination is all women of childbearing age. For short-term reduction in the congenital rubella syndrome the following actions are recommended:

1. Vaccination of all women of childbearing age with a vaccine containing the rubella antigen: Measles-Mumps-Rubella (MMR), Measles-Rubella (MR), or Rubella);

2. Vaccination of most girls and boys between 5 and 18 years of age with MMR, MR, or Rubella vaccine.

3. Inclusion of the MMR vaccine in the routine vaccination schedule for boys and girls.

It is important to note that the simple addition of the MMR vaccine in child vaccination programs will not reduce the incidence of congenital rubella syndrome for approximately 20 years. In some programs for rubella control, one of the recommended strategies is to vaccinate school-age girls (10-14 years) not previously vaccinated in order to increase the impact on prevention of congenital rubella. Clearly, the exclusive immunization of school-age girls will have an impact on this syndrome but will not interrupt transmission of the rubella virus, since it will continue to circulate among boys of this age.

The following epidemiological surveillance measures should be undertaken with the introduction of this vaccine:

1. Every suspected case of measles that is IgM negative for the measles virus should be studied for rubella;

2. Surveillance of congenital rubella syndrome should be undertaken; and

3. Surveillance of diseases accompanied by fever and skin eruptions during pregnancy should also be instituted.

Introduction of the MMR vaccine or another vaccine containing the rubella antigen should only take place when there is a policy for the control of congenital rubella syndrome or of the disease in the long term and when it is certain that the resources to support a long-term program will be available.

3. Haemophilus influenzae B Vaccine (Hib)

Invasive infections by *H. influenzae,* type b are a major cause of bacterial meningitis in the first years of life. Hib is responsible, moreover, for epiglottitis, septicemia, septic arthritis, osteomyelitis, pericarditis, pneumonias, and otitis.

Vaccines derived from capsular polysaccharides yielded good immunogenicity in adults, but were not as effective in inducing levels of protection in the group at greatest risk (infants under 18 months). However, when conjugated with protein, they became protective in this age group.

Several conjugated vaccines have been developed that are safe and 95% effective. They should be refrigerated at 2-8 °C. They are administered intramuscularly or subcutaneously in a dose of 0.5 ml. There is no report of significant adverse reactions. The recommended vaccination schedule is three doses at 4-week intervals, beginning at 2 months of age.

Application in the developing countries on a grand scale should be preceded by epidemiological studies on the patterns of the disease, and providing a breakdown of the prevailing type of *Haemophilus influenzae* and its effects on child morbidity and mortality by age and risk groups. In addition, a cost-benefit analysis should be done and the priorities regarding public health problems determined. However, when high mortality from meningitis attributable to Hib is identified and the vaccine is available, vaccination of the affected population is recommended.

4. Typhoide Fever Vaccine

Typhoid fever is a bacterial disease caused by *Salmonella typhi* and causes many mild and atypical infections related to the poor sanitation conditions and hygiene of the population. Systematic vaccination is not currently recommended. However, the strategy of vaccinating people at risk in endemic areas or in epidemic situations is utilized.

Three types of vaccines are available; they should be kept under refrigeration at a temperature of 2-8 °C:

4.1 Inactivated Cell: 0.5 ml dose with a 2-dose schedule with a 4-6 week interval; 70%-80% effectiveness. Immunity is conferred for approximately three years.

4.2 Vi Polysaccharide Antigen: a single 0.5 ml dose confers 70%-80% protection; application indicated in children over 18 months. Immunity lasts about three years.

4.3 Oral Vaccine (Attenuated Live *S. typhi* TY21A): 3-dose schedule, with 70%-80% effectiveness. It is thermolabile. Applied in adults and children over 6. Confers immunity for three years or more.

5. Yellow Fever Vaccine

Yellow fever is an acute viral infection of short-term duration and varying severity. The case-fatality rate among

indigenous populations of endemic regions is under 5% but may exceed 50% in nonindigenous groups and in epidemics. The disease confers lasting immunity.

The vaccine is manufactured from attenuated live virus. It confers excellent immunogenicity (>95%), high safety, and protection. Immunity lasts at least 10 years. The recommended schedule in all endemic countries, geared mainly toward risk groups (migrant workers, rural population, travelers, etc.) consists of a single dose, administered subcutaneously, after 6 months of age. The dose per person should contain a minimum titre of 1,000 DL. In endemic regions it should be integrated into the immigration program and administered simultaneously with the measles vaccine.

The yellow fever vaccine should be refrigerated. For extended storage, it keeps better frozen (-20 °C).

6. Meningococcal Meningitis Vaccine

Meningococcal meningitis is an acute systemic infection caused by the *Neisseria meningitidis* (meningococcus) bacterium, which is characterized by different serogroups (A, B, C, Y, and W135). It occurs in endemic or epidemic form, causing high mortality and child morbidity, chiefly in the under-4 age group. Historically, serogroup A strains have been responsible for the principal epidemics described, but epidemics of serogroup B have recently occurred in the Region.

Currently, there are safe and effective vaccines derived from capsular polysaccharides in different combinations. However, they are not very immunizing in children under 2, and the duration of protection is short, its integration into routine child vaccination programs is not recommended. Nonetheless, they are considered highly effective and important for the control of epidemics. They should be refrigerated at 2-8 °C.

Three types of vaccines are available:

6.1 Monovalent A or C: the recommended schedule is a single dose (0.5 ml), deep subcutaneous or intramuscular, for persons over 2 years of age. Protection lasts from 1 to 3 years.

6.2 Bivalent B and C: the latest studies in the Region conclude that at present the effectiveness of the available vaccines is still uncertain for the under-4 age group.

6.3 Bivalent A+C: most commonly used in epidemic situations.

6.4 Quadrivalent A, C, W135 and Y: use in specific groups (military recruits).

7. Pneumococcus vaccine

Streptococcus pneumoniae (pneumococcus) is a major cause of severe pneumonia, bacterial meningitis, and a host of infections that are responsible for high morbidity and mortality in children under 5 years and adults.

Derived from capsular polysaccharides, the most commonly used vaccine is comprised of 23 serotypes that account for over 90% of the infections. The vaccine elicits a good immunological response in older children and adults, but because of its low effectiveness in children under 2 years it is not recommended for use in routine child vaccination programs.

In some countries the recommended schedule is the administration of a single dose of 0.5 ml (containing each of these 23 polysaccharides), either subcutaneously or intramuscularly, in adults and children over 2 at high risk (chronic disease, renal insufficiency, cardiovascular disease, immunodeficiency, etc.). The vaccine should be refrigerated at 2-8 °C and may be administered simultaneously with other vaccines.

Source: Special Program on Vaccines and Immunization (SVI), PAHO.

C O N G R E S S E S

IV Argentinian Congress on Epidemiology and Health Care *(VI Seminar on Health Services Administration)*
RONTAG Convention Center
Buenos Aires, Argentina: **2 to 4 September, 1996**

Main topics:

• Epidemiological techniques for rapid assessment and interventions; • Georeferencial epidemiological analysis in public health; • Advances in epidemiology and control of nosocomial infections; • Qualitative methods in epidemiology; • Etnoepidemiology, critical epidemiology and social epidemiology; • Strategical planning; • Total quality management.

For more information: Ministerio de Salud y Acción Social, Subsecretaria de Atención Médica, Buenos Aires, Argentina. Teléfono: 54 1 381-0852 y 383-4814.

III Regional Congress of Information on Health Sciences

Fifth Meeting of Latin American and Caribbean Health Sciences Information Systems
Sixth Meeting of the Brazilian Health Sciences Information Network **October 16-18, 1996**

The III Regional Congress of Information on Health Sciences will be held from October 16 through 18, 1996 in Rio de Janeiro. Its principal objective is to train health professionals and information specialists with the latest information technologies and applications needed to enhance their skills and work in the area of health sciences.

Central Theme: Interrelationships of Information Technology:the near future.

Convergence of the Technologies - Information Industry: future tendencies; interactive training and learning in the medical sciences; telemedicine.

Architecture of Information System - Information superhighway; INTERNET: Protocols and standards; Information data bases.

Virtual Library: Reality of the new millennium; scientific publication in cyberspace; emerging human resources.

Systems of functions in the health sciences: administration and decision making - Specialized systems: Genome; Epi-GIS; Local Health Information Systems; Information with added value.

During the Congress there will be conferences, round tables or panel discussions, and poster presentations open to all who are interested. The specialty seminars will last two days. Informatics and Biotechnology and Development of Epidemiological-Geographical-Information-Systems (EPI-GIS).

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The Fourteenth International Course in Applied Epidemiology México: **1 to 26 July, 1996**

The Fourteenth International Course in Applied Epidemiology, conferring diploma status recognized by the National Autonomos University of Mexico, will take place from 1 to 26 of July 1996 in Mexico, D.F., under the coordination of the *Directorate of Epidemiology of the Ministry of Health of Mexico*. This series of 15 courses are designed to cover two broad areas: the first includes theoretical and methodological aspects of epidemiological practice and the second, specific subject areas of applied epidemiology, such as epidemiology of communicable diseases and of chronic diseases, enviromental epidemiology and epidemiology of addiction. Other subjects are: basic and intermediate epidemiology; basic and intermediate biostatistics; design of research protocols; introduction to Epi-Info 6.0 for epidemiologic analysis; multivariate analysis in epidemiology; selected topics in clinical epidemiology and injury epidemiology.

For further information, contact: Dirección General de Epidemiología; Francisco de P. Miranda núm. 177; Col. Lomas de Plateros; Tel: 593-36-61. Registration deadline: 14 June, 1996.

25 years without smallpox in the Americas

Following an outbreak of 17 cases of smallpox in Penha, Rio de Janeiro, then State of Guanabara, Brazil, from 22 December 1970 to 6 March 1971, two more cases have occurred in patients who were infected with smallpox while hospitalized for pemphigus. Because of their dermatosis, neither of these patients was vaccinated against smallpox. On 2 March 1971, two children in the eruptive phase of smallpox were admitted to the Eduardo Rabelo Hospital in Rio de Janeiro, occupying a room adjoining the ward for skin diseases where both pemphigus patients were hospitalized. The first of the two secondary cases was a 28 year old male admitted to the hospital on 12 February; he began to have fever on 23 March and rash on 27 March. The second patient, an 18 year old male, was admitted on 11 March and presented symptoms of smallpox on 19 April. **This was the last case of smallpox in the Americas.**

The last countries to report cases in the Region of the Americas were: Brazil, which had reported cases since 1920 and for the years 1968 to 1971 reported 4372, 7407, 1771 and 19 cases, respectively; Argentina, which reported 24 cases in 1970; Uruguay, which reported 3 cases in 1969; and French Guiana, which reported one case in 1968.

Smallpox, described by the historian Macaulay as "the most terrible of all the ministers of death", has been a scourge of mankind since ancient times. Repeated epidemics have across the world, decimating populations and altering the course of history. Not until Jenner demonstrated, exactly 200 years ago, in 1796, that inoculation with cowpox would protect against smallpox was there hope that the disease could be controlled.

The World Health Assembly, from the time of its first meeting in 1948, expressed increasing concern about smallpox. In 1958 it reviewed the question of the eradication of smallpox from the world and in 1959 recommended that smallpox-endemic countries should launch special programs for that purpose. A number of countries became smallpox-free in the following years, but in the major endemic areas of Africa, Brazil and South-East Asia, little progress towards eradication had been made. In 1966, the Nineteenth World Health Assembly decided that an intensified program was necessary, financed from the regular budget of the Organization, and it requested countries, multilateral and bilateral agencies to provide additional assistance.

The intensified program called for the vaccination of at least 80% of the population within a period of two or three years, during which time reporting systems and surveillance activities would be developed that would permit detection and elimination of the remaining foci of the disease.

Progress was slow in some countries but rapid in others. The countries of west and central Africa became smallpox-free in 1970, Brazil in 1971, Indonesia in 1972, and the countries in eastern and southern Africa in 1973. Major campaigns by the countries of the Indian subcontinent achieved eradication there between 1973 and 1975. Finally, in the Horn of Africa, Ethiopia became smallpox-free in 1976 and Somalia in 1977.

The eradication of smallpox in the Americas and in the world has left several positive elements such as the development or the strengthening of epidemiology units in the ministries of health and the organization of epidemiological surveillance and control programs for other communicable diseases. At global level the experience acquired in the smallpox eradication program led to the creation of the current and most successful Expanded Program of Immunization.

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Source: Division of Health and Human Development, Health Situation Analysis Program, HDP/HDA, PAHO.

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