GIS and Public Health in the Americas

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2008 ESRI Health GIS Conference. GIS Shaping Global Health. Washington, D.C. October 1, 2008

Pan American Health Organization

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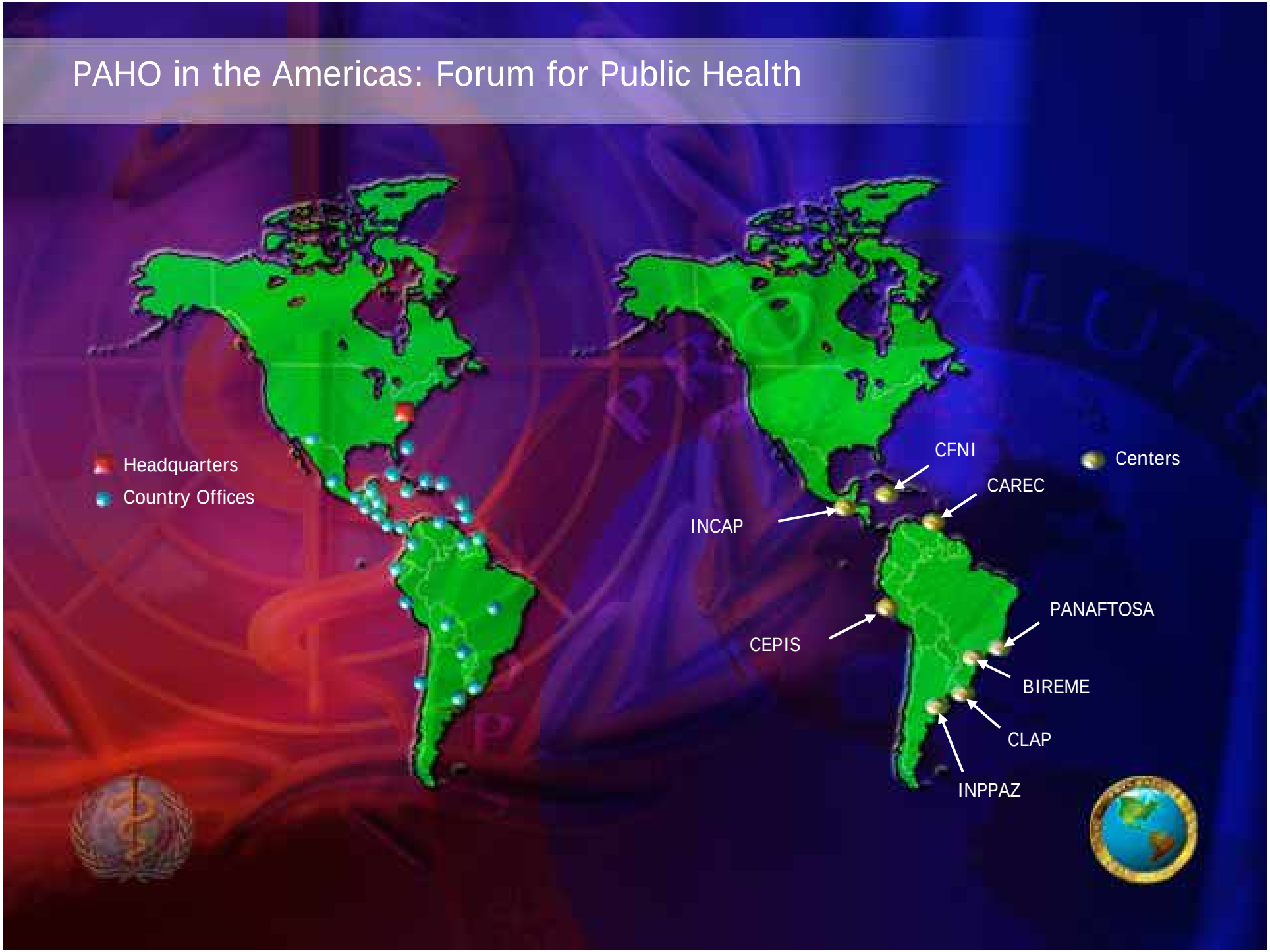
OUTLINE

- Brief History of PAHO
- Developing a GIS-Epi Model
- GIS-Epi Applications
- Challenges of Global Public Health
- Next Steps

PAHO in the Americas: Forum for Public Health



Forum for Public Health in the Americas

Mobilizing Ministries of Health for GIS

PAHO-GIS Team

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PAN AMERICAN HEALTH ORGANIZATION
WORLD HEALTH ORGANIZATION

SUBCOMMITTEE ON PLANNING AND PROGRAMMING OF THE EXECUTIVE COMMITTEE

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GEOGRAPHIC INFORMATION SYSTEMS IN HEALTH

The selection, collection, organization, maintenance and use of data and information to describe, analyze and document the health situation of the countries of the Region of the Americas are essential functions of the Pan American Health Organization (PAHO). In this respect, PAHO collaborates with the Member States to increase the capacity for health situation analysis and to bolster the capacity to document and evaluate inequities in health and their determinants.

This knowledge assists in the formulation of health and environmental policies, the reorganization of health services, health promotion, disease prevention and control, programming and evaluation for interventions, and resource mobilization. The technical health information systems contribute to knowledge on the health and well being of the population and stimulate the use of available information and analysis.

This document describes the use of Geographic Information Systems in health (GIS-Epi) as one of the platforms of the PAHO Core Data/Country Profile initiative that is being developed. The regional technical programs, the PAHO country offices, and the regional centers have been working with the Member States to improve the Organization's ability to use new tools and technology to describe, analyze and document the situation and trends of health problems in the Region that it must address. The GIS-Epi concept involves the design, development, and utilization of Geographic Information Systems (GIS) tools for description of the health situation, epidemiological analysis, and public health management.

The GIS comprise powerful analytical support tools for decision-making that involves the integration of spatially referenced data to perform problem-solving operations. This technology is currently available for personal computing and, therefore, is accessible to the health sector. The integration of GIS and epidemiological methods and techniques in public health, including surveillance, situation analysis, and program evaluation and planning areas, facilitates the epidemiological analysis of health events and their determinants required for public health interventions and decision-making.

This document is presented to the Subcommittee on Planning and Programming to inform Members on progress to date and expected developments in this field, and to seek feedback and input from them.

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GIS-Epi Milestones

- **1993** – First PAHO GIS Workshop for Malaria Control. Chapala, México. 23 participants from the Americas
- 1993 – IACO III Iberoamerican Conference on Onchocercosis. Amazonas Venezuela (Brazil, Colombia, Ecuador, Guatemala, Mexico and Venezuela).
- 1994 – GIS Applications using Epidemiological Stratification and Focalization
- 1995 – Launching of Core Health Data initiative
- 1995 – GIS-Epi Collaborative Groups Network: Chile, Cuba, Guatemala and México
- 1995 – Organization of First International Symposium on Computer Mapping in Epidemiology and Environmental Health, Tampa FL.
- 1995 – SIGEpi development over MapInfo using MapBasic
- 1996 – First Draft of the book “GIS in Health: Basic Concepts”
- 1996 – First Health Indicators Atlas in the PAHO Web
- 1997 – Using ArcView as standard GIS

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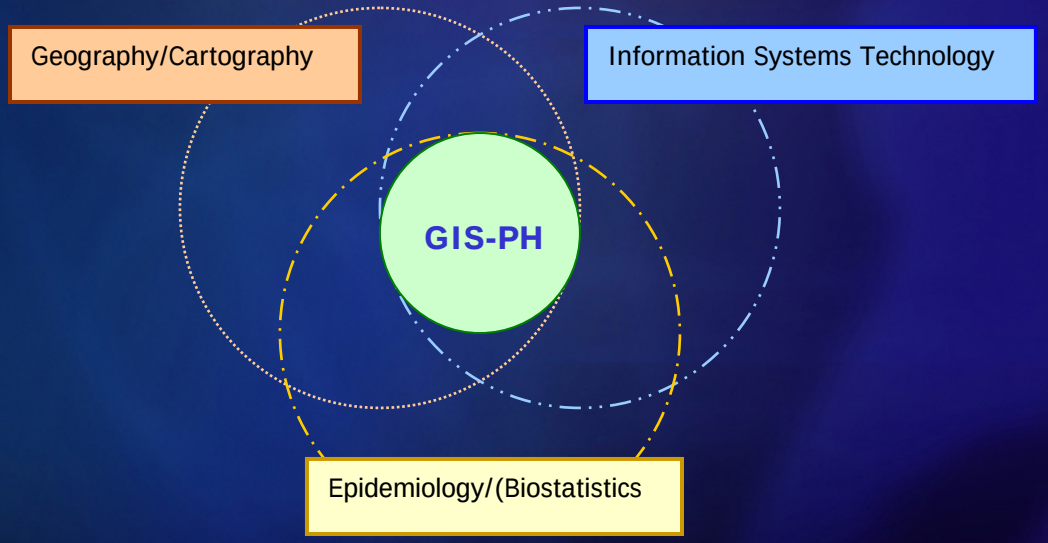
Geographic Information System in Public Health (GIS-PH)

- **Set of interacting components that use spatial reference data and health-related information to analyze and synthesize large quantities of data and information to support, orient, and evaluate public health interventions and decision-making in a territory or defined space for a specific time period.**

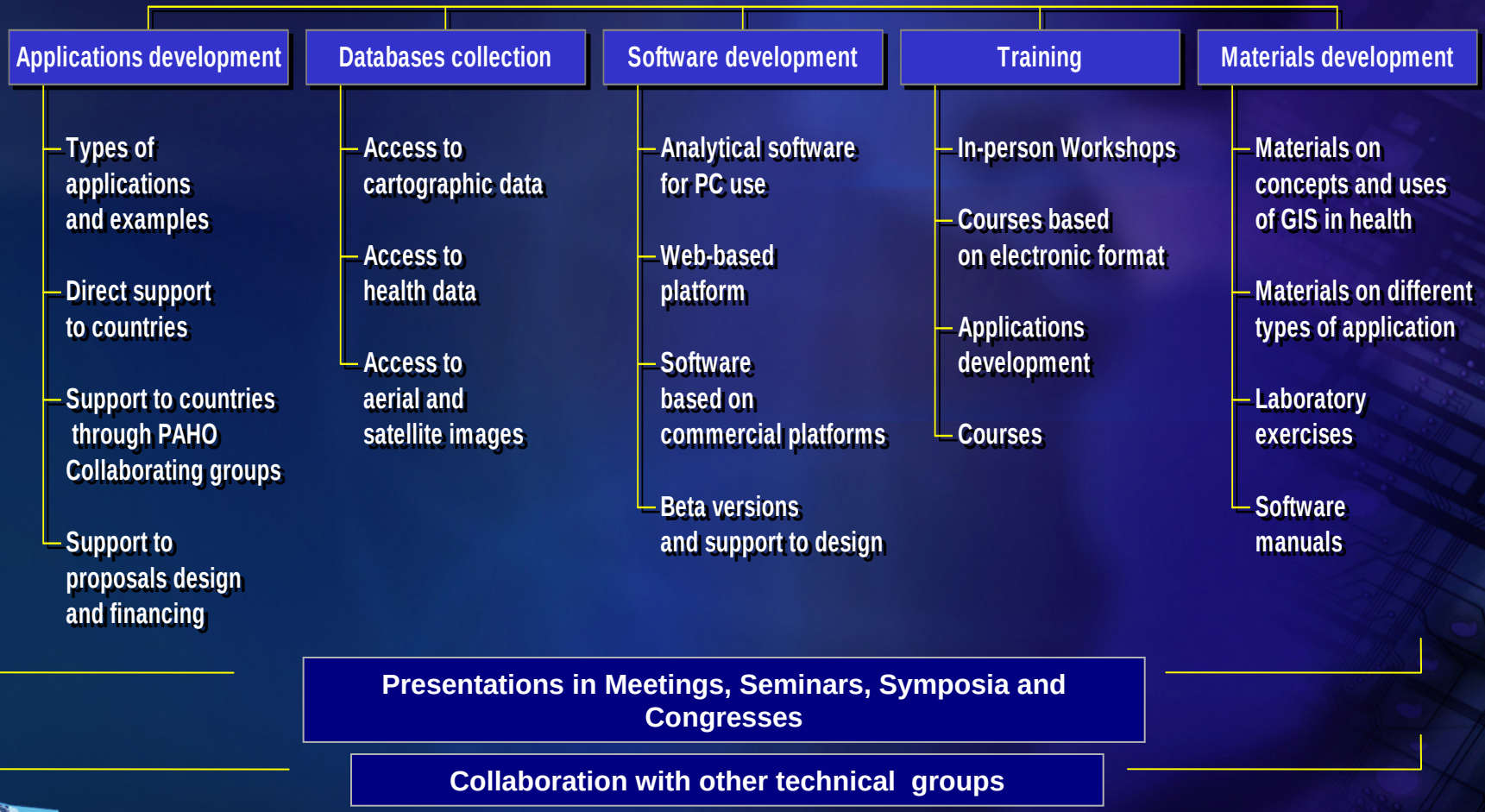


Geographic Information Systems (GIS) in Health

- **Concept encompasses the design, development, and utilization of GIS tools for the description of health situations, epidemiological analyses and public health management.**

- **Some of its main applications are:**
  - **Spatial description/analysis of health events**
  - **Public health surveillance**
  - **Identification of environmental and occupational risks**
  - **Health situation analysis in a given area and population**
  - **Analysis of health patterns/differences at various levels**
  - **Identification of high risk groups and critical areas**
  - **Generation of operational research hypothesis**
  - **Planning and programming of health services**
  - **Evaluation of public health interventions**

GIS-Epi Project in the Americas



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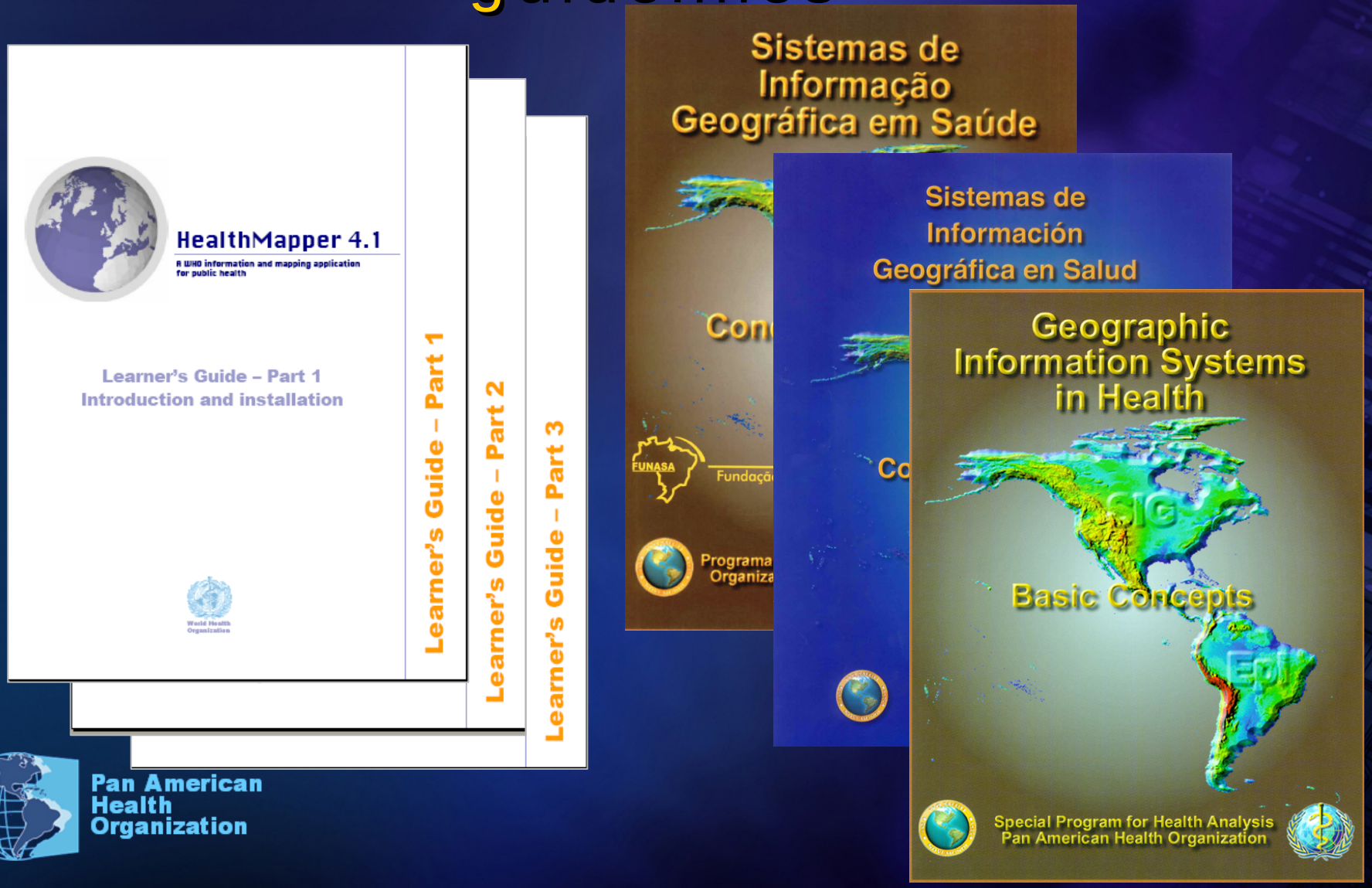
Forum for Public Health in the Americas

Produce and disseminate guidelines



Pan American Health Organization

sigepi

Geographic Information System in Epidemiology

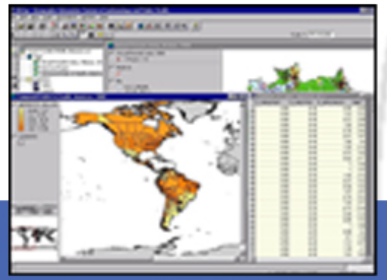
SIGEpi - Geographic Information System (GIS) is designed for applications in Epidemiology and Public Health including specific analytical procedures for equity and poverty mapping, health situation and spatial data analysis, epidemiological assessment and biostatistcs. These are presented in a simplified way, in a friendly environment and in multiple languages.

SIGEpi is developed by the Area of Health Analysis and Information Systems (AIS) of the Pan American Health Organization (PAHO). This product is part of the PAHO Technical Cooperation Project "Development and Application of Geographic Information Systems in Epidemiology and Public Health".

Features:

- Creation of thematic maps utilizing measures and health indicators.
- Response to questions on the impact of spatial and geographical variables on health problems.
- Calculation, standardization, and spatial smoothing of rates and proportions.
- Descriptive statistics, correlation, and linear regression.
- Identification of Critical or Priority Areas and Populations.
- Construction of a composite index for example, index of unmet basic needs in health, poverty index, etc.
- Identification and detection of both spatial and time-space clusters.
- Measurement of the association of environmental/ecological exposure factors and health events in epidemiological studies of case-control and cohorts.
- Assessment of accessibility to health services.

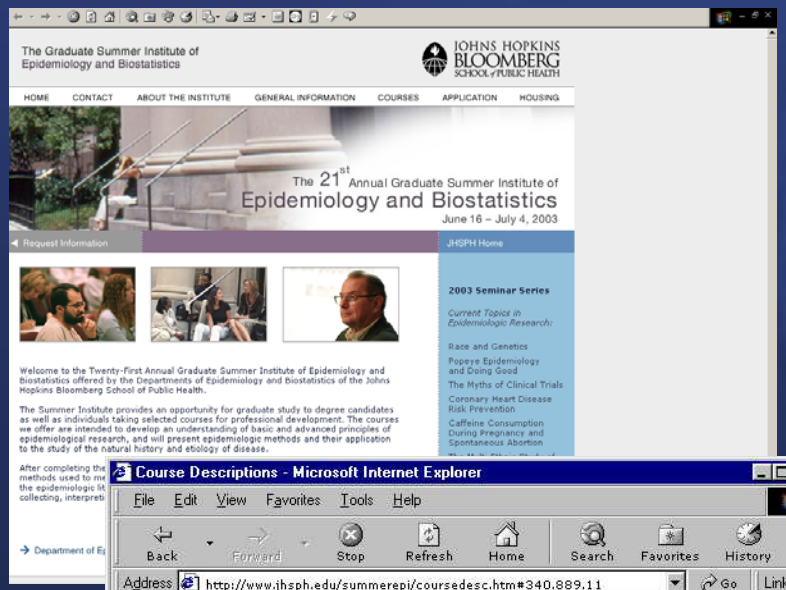
It is an in-house development based on COM/DCOM tecnnology.
Using Visual Basic, third party components and powered by ESRI.
Intended for Personal Computers and Windows Operating System.

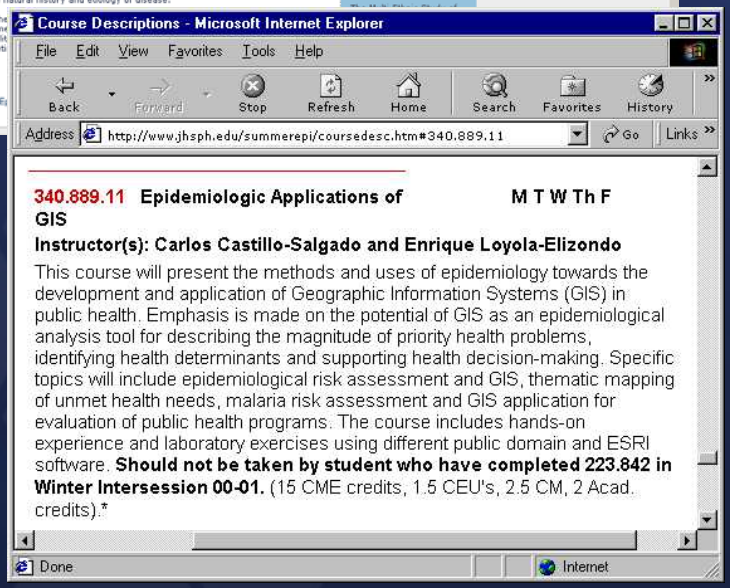


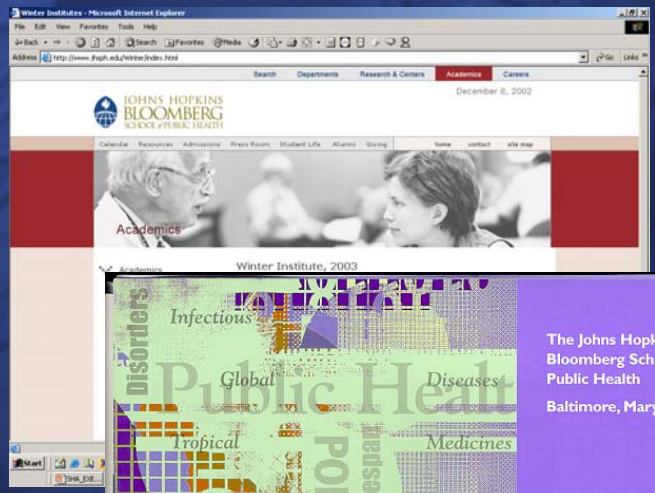
http://ais.paho.org/sigepi

ais@paho.org

PAHO/JHU Epidemiologic applications of geographic information systems course

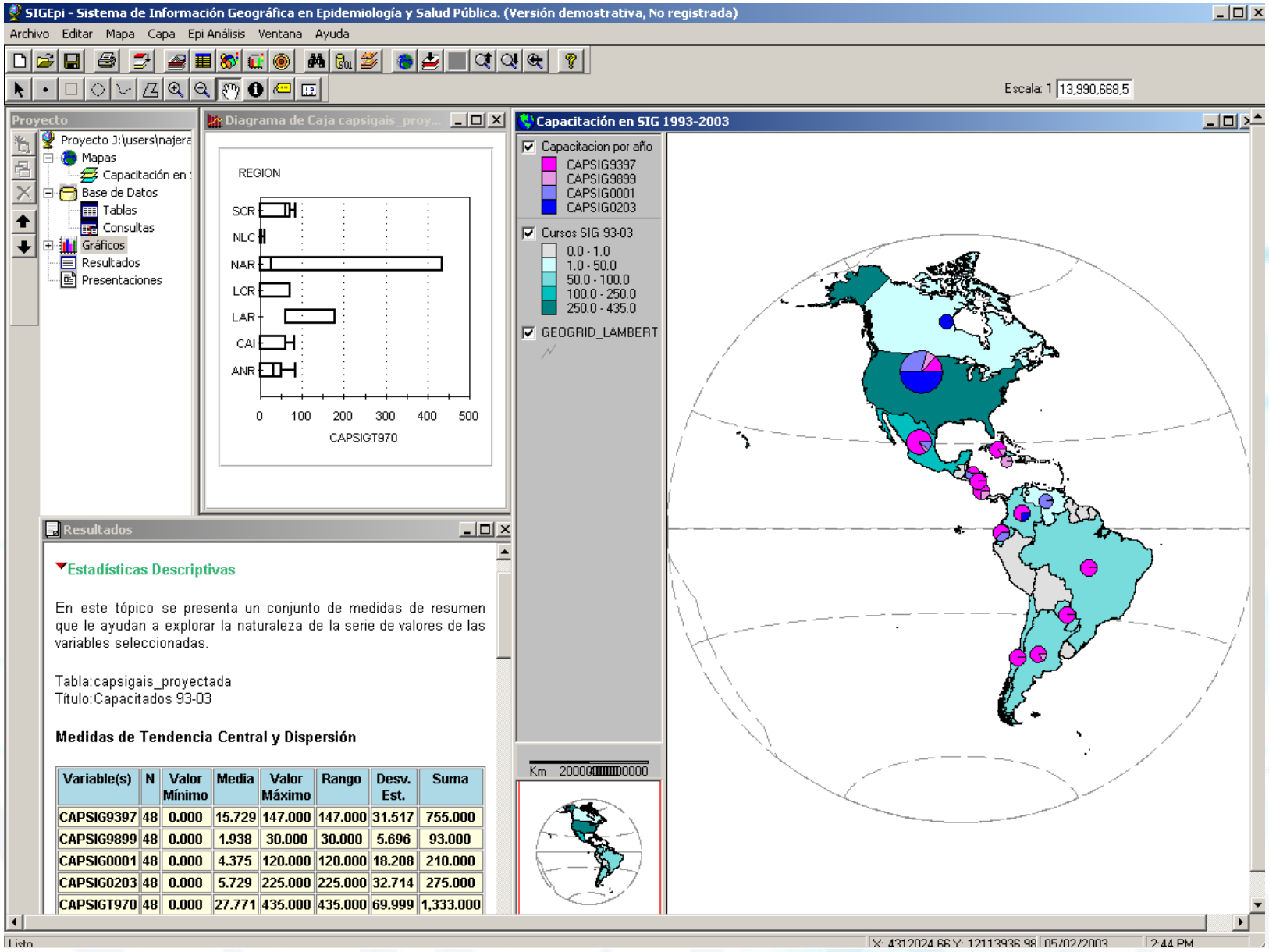






PAHO National GIS Workshops

PAHO XXI IN ACTION



Launching SIGEpi Software in Brazil

PAHO and Ministry of Health authorities of Brazil launching SIGEpi.
V Brazilian Congress of Epidemiology, Curitiba, Brazil

World Health Organization

Pan American Health Organization

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Health Metrics using GIS-PH applications

PAHO XXI IN ACTION

Environmental health

Environmental risks and vulnerability

Healthy spaces

Health needs

Health Situation Analysis

Public Health Surveillance

Critical areas (groups) identification

Health services response

Health services availability and coverage

Accessibility

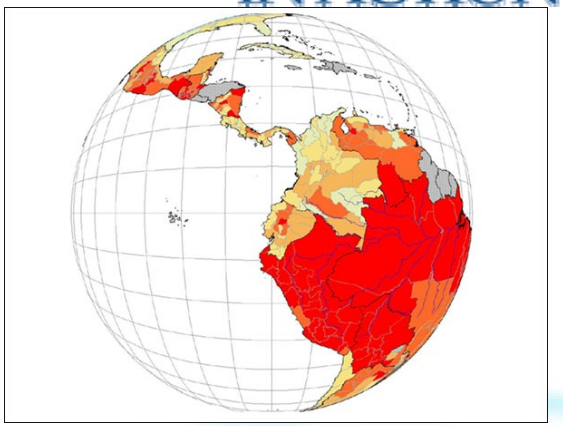
Public Health Programming and Planning

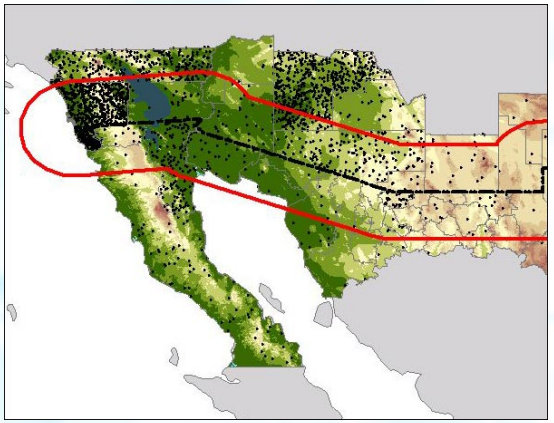
Intervention impact evaluation

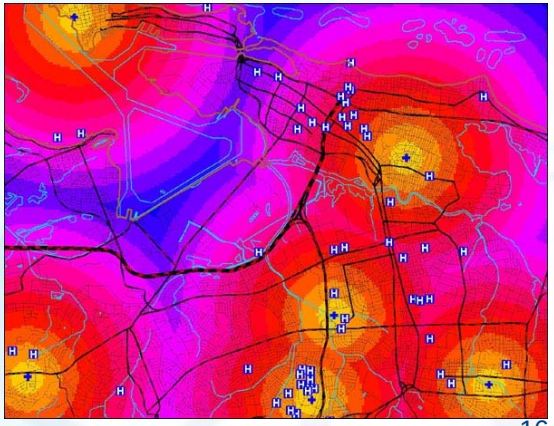
Generic

Hypothesis generation for operational research

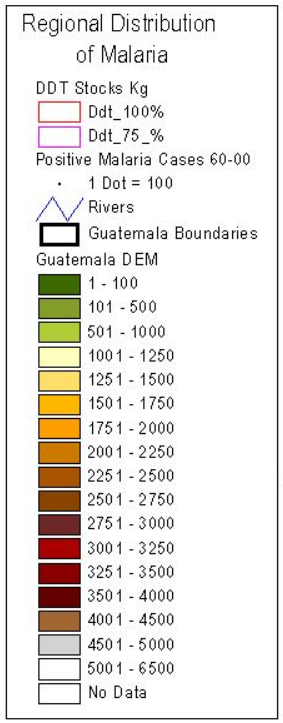
Health Atlases

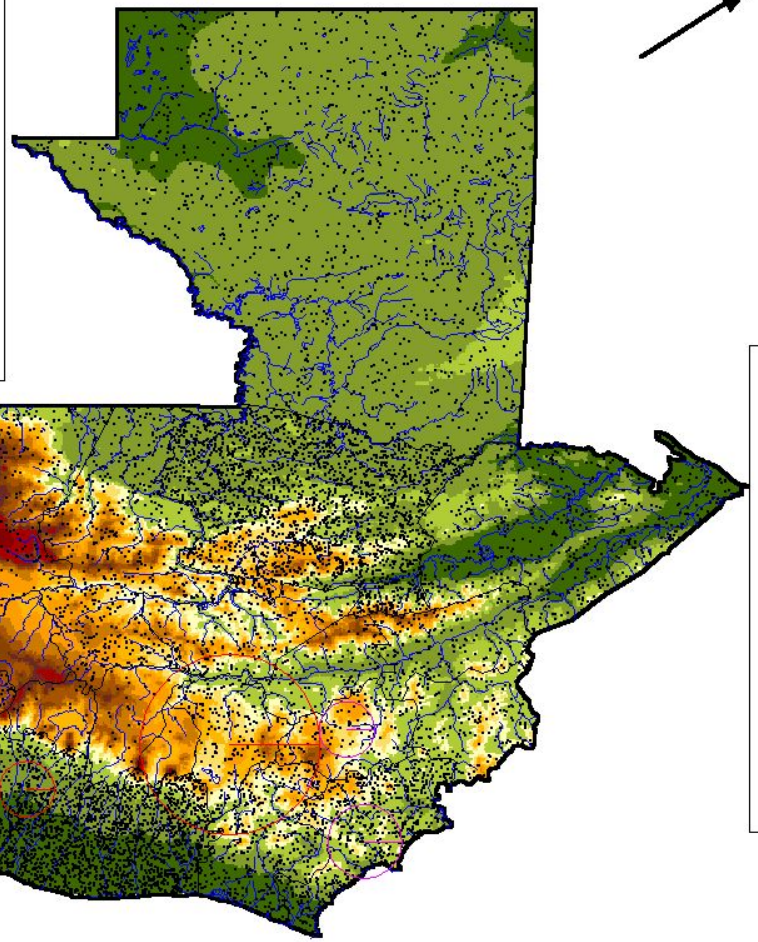


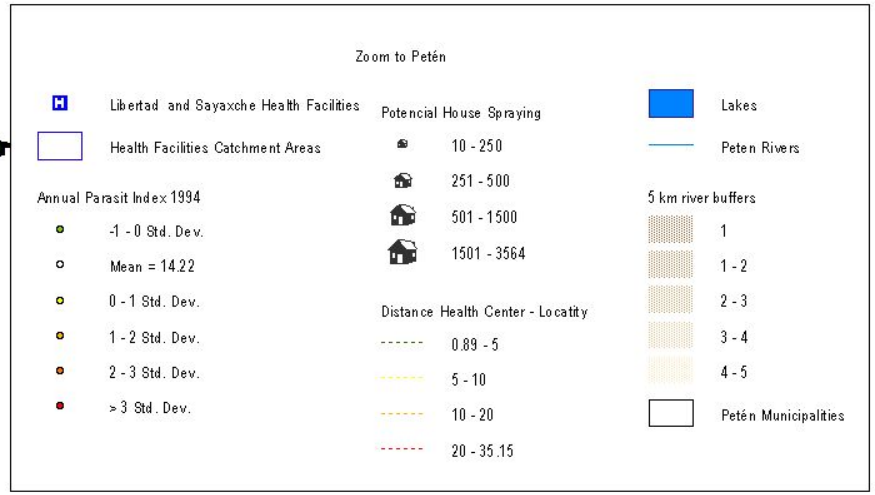




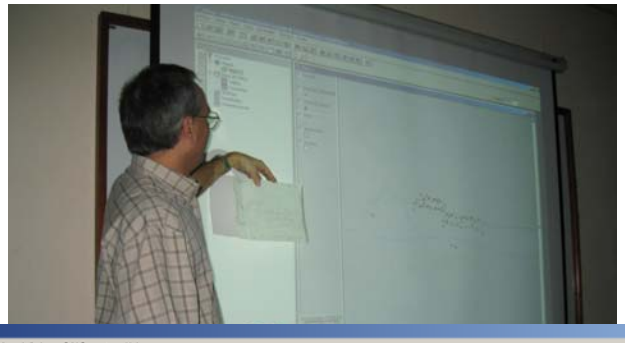
Epidemiological Assessment of Malaria Distribution in Peten, Guatemala

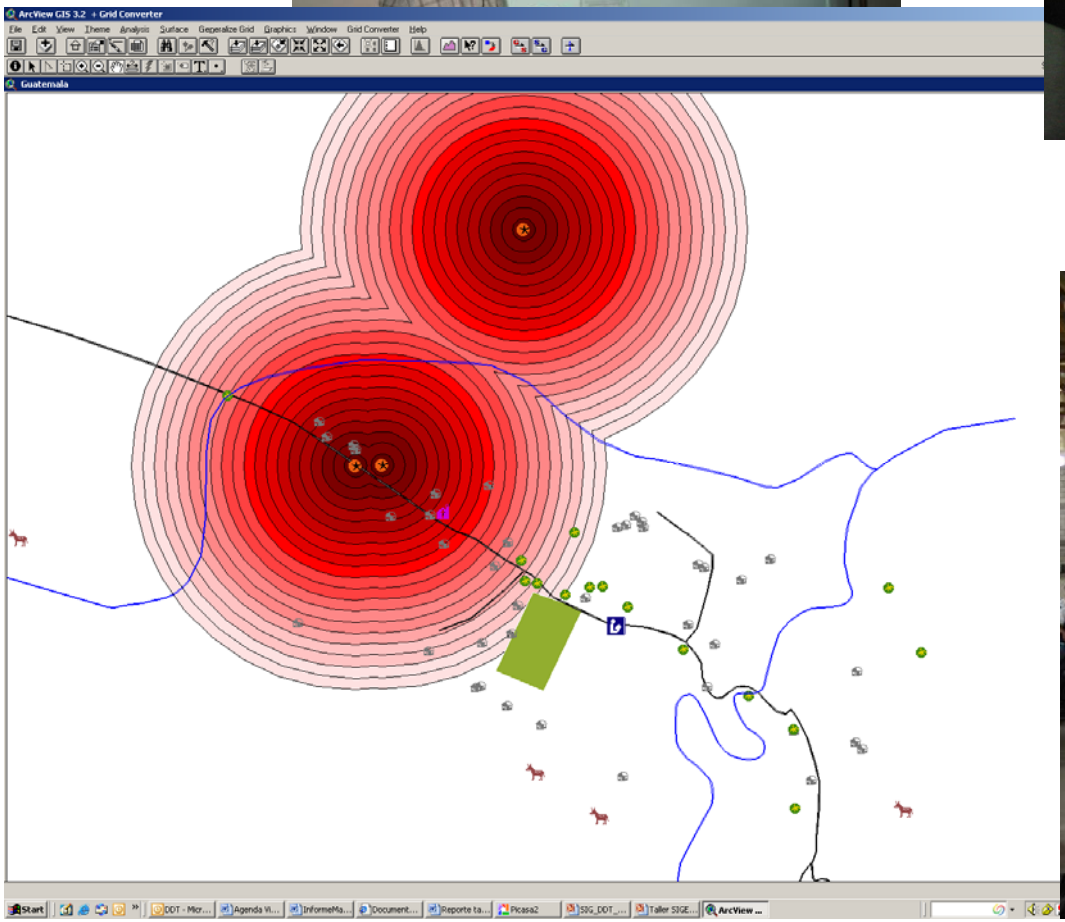






Evaluation of interventions and public health programs
GUATEMALA





Monitoring Global Health Initiatives
Clusters of Severe Growth Retardation in GT, HN and ES
Hunger Reduction MDG Target

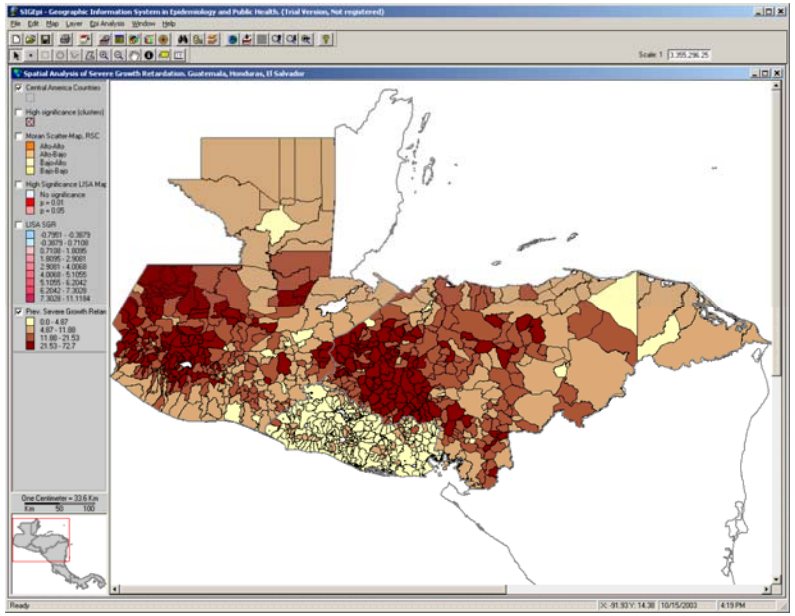
Objective: Study of spatial distribution of malnutrition in three countries (Guatemala, Honduras, El Salvador) of Central America.

Methods: Use of Severe Growth Retardation (SGR) in children of 6 years old as indicator of malnutrition. Application of the spatial cluster detection techniques: spatial autocorrelation, local indicators of spatial autocorrelation and Moran's Scatter-plot. The study area included Guatemala, Honduras & El Salvador, and municipalities as geographic units.

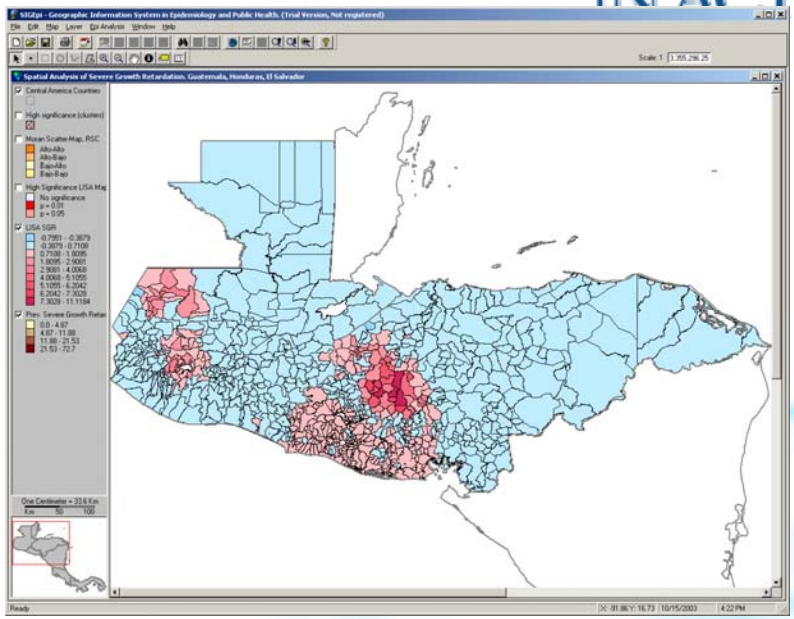
Results: The spatial analysis shows a strong positive spatial autocorrelation ($I = 0.71$, $p <= 0.01$) of SGR, presence of clusters. The local indicator of spatial correlation reveals three cluster of high rates of SGR, two of them at western of Guatemala and one at western of Honduras. All of them located in mountains zones and with no-agricultural land use. A cluster of low prevalence of SGR was detected in El Salvador.

The identification of clusters allows to focalize the interventions and to investigate related socioeconomic and demographic factors.

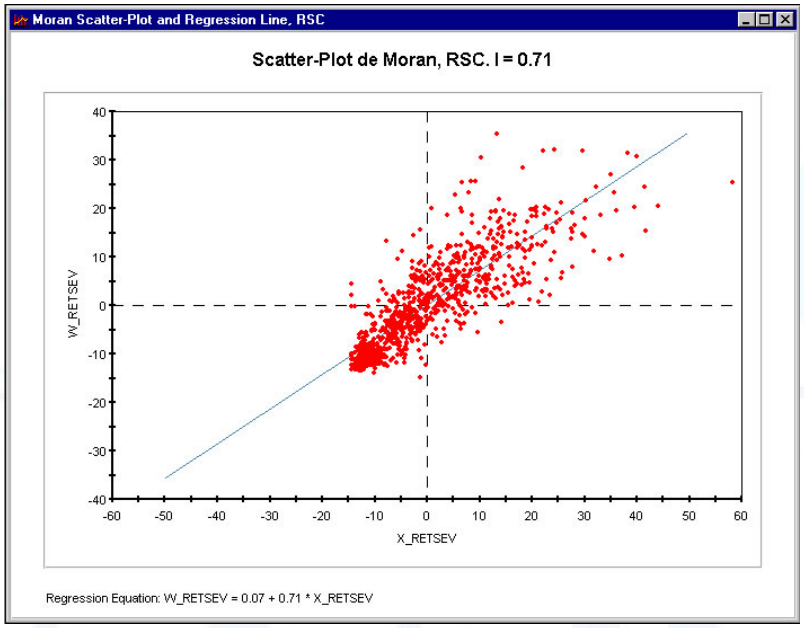
Clusters of Severe Growth Retardation in GT, HN and ES



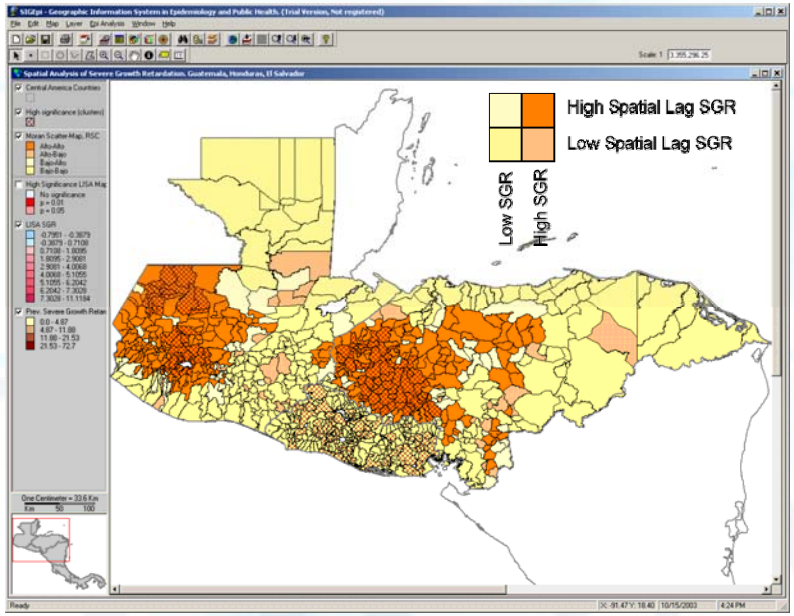
Choroplet map, cuartil intervals of SGR. Moran's I = 0.71, p<0.01)



LISA Map. Local Indicator of Spatial Autocorrelation



Moran's Scatter-Plot. SGR vs. Spatial Lag SGR.



Moran's Scatter-Map. High significance clusters of SGR.

Orient decision-making and planning

Situation Analysis (HSA),
Assessment of coverage and access to Health Services in Honduras

Objective:

To develop a GIS for Health Situation Analysis (HSA) assessment, identify problems of availability and coverage of Primary Health Care and low geographic accessibility areas in Honduras

Methods:

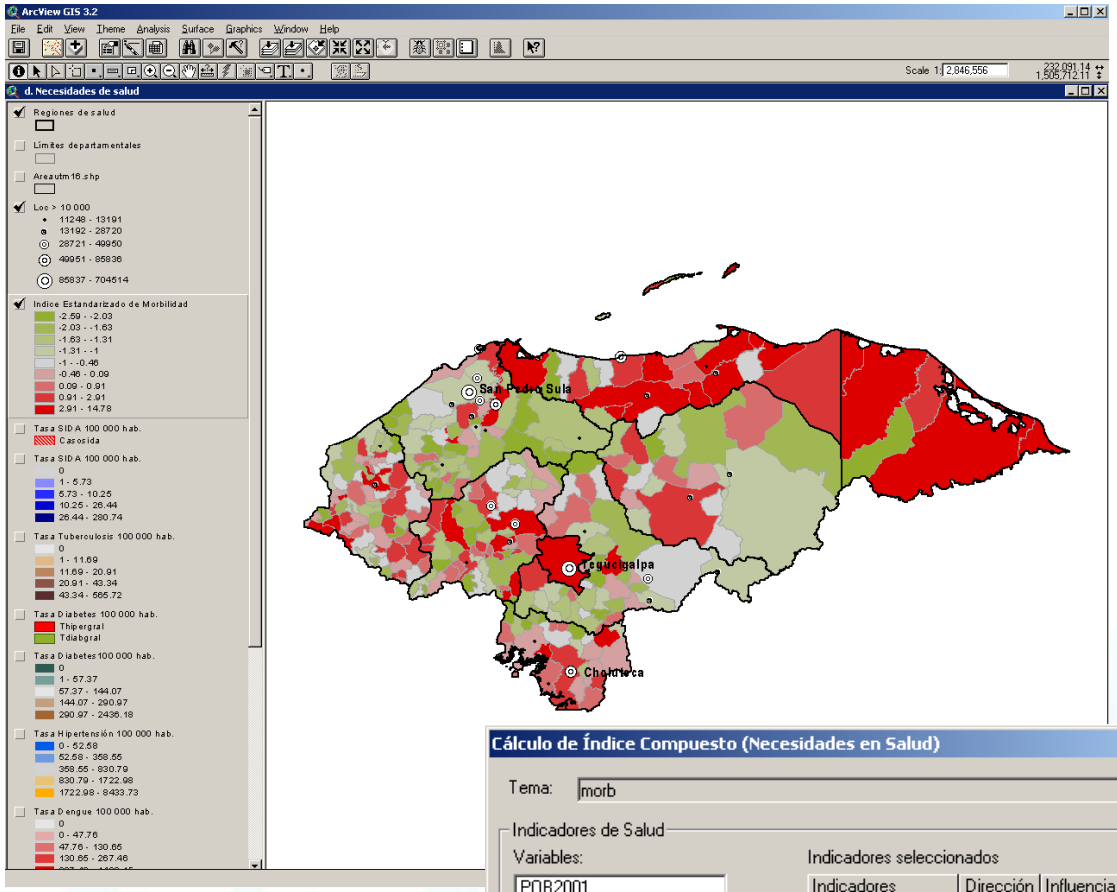
A multiple-dimension index was developed using a selected set of core health indicators. Correlation analysis allowed for the selection of non-collinear indicators of the model.

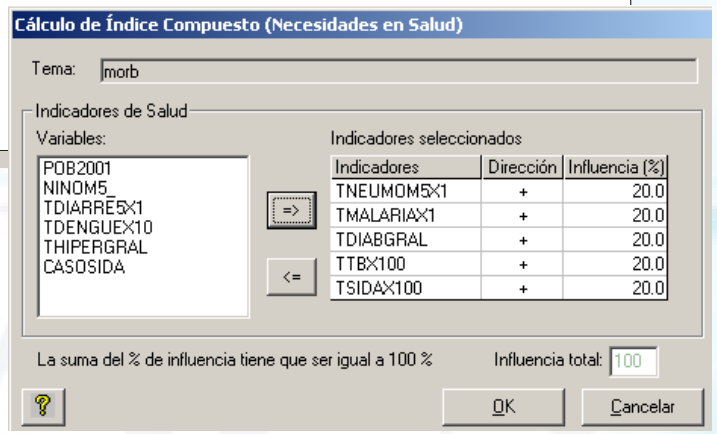
Results:

The results of this health situation analysis were used to identify the level of coverage of PHC in Honduras and its links with geographic accessibility.

Orient decision-making and planning

Unmet Health Needs. Morbidity Standardized Index

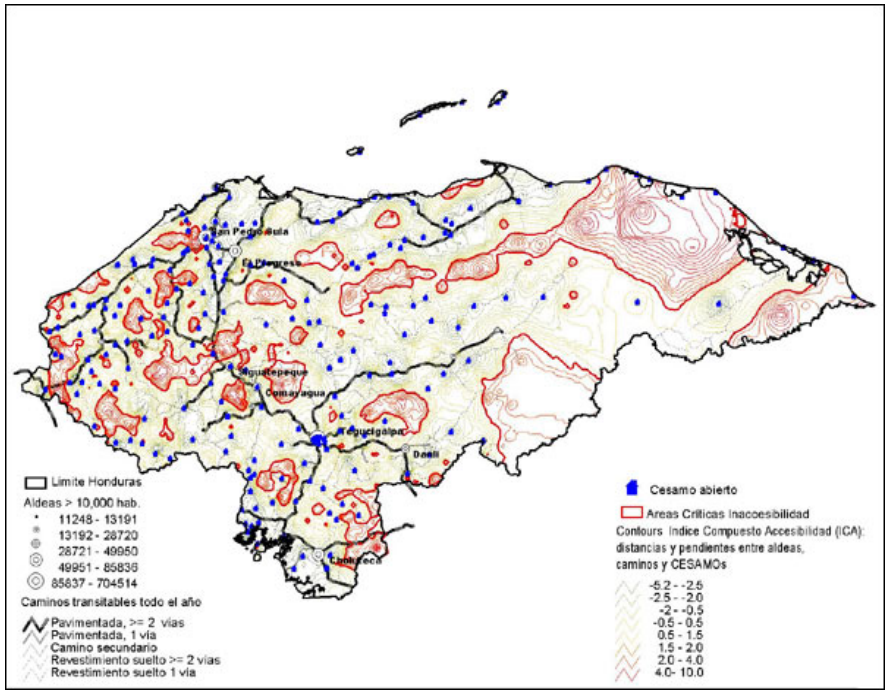


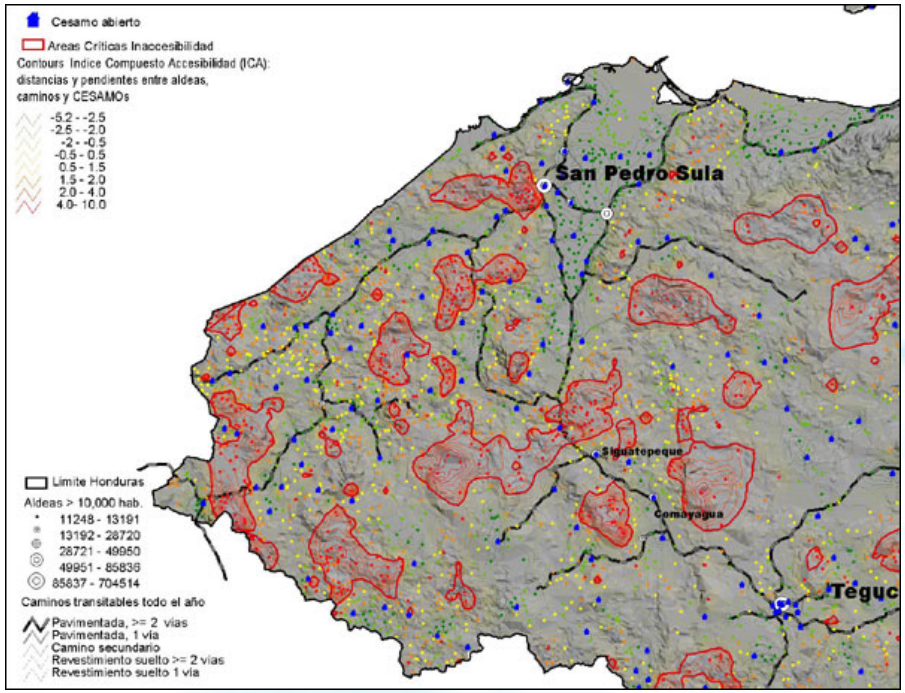


- **Sum of normalized values of morbidity indicators (Z score)**
- **RATES X 100 000:**
  - **Pneumonia Rate among children under 5**
  - **Malaria Rate**
  - **Dengue Rate**
  - **Tuberculosis Rate**
  - **AIDS Rate**
  - **Diabetes Rate**

- Developed with Sistema

Low accessibility critical areas





Accessibility Index (ICA **constructed with SIGEpi 1.0)**

- **Distances (km) and slopes to nearest facility**
- **Calculation of z scores**
- **Linear interpolation of community's ICA Values Selection of 2 Std Deviation values of ICA to define critical areas**

RESULTS:

In Low Accessibility Critical Areas there are 807 communities with 638, 856 inhabitants.

Orient decision-making and planning

PAHO XXI IN ACTION

Policy-making Impact

- **Resources for the Secretary of Health**:
  - On the National Congress, it was instrumental for negotiation for new medical staff positions
  - Re-allocation of budget to reorganize and open key health centers
- **The GIS application was implemented in four strategic areas of his administration**:
  - Ministry of Health PC
  - Epidemiology
  - Health Planning
  - Disasters and Emergencies
- **Simplification of the application to be coordinated by health staff**

4 TIEMPOS DEL MUNDO **SALUD** JUEVES 2 DE OCTUBRE DE 2003, WASHINGTON, D.C.

Congreso de salud resalta papel de la información en la prevención

CORTESIA DE CARLO EISNER

SECRETARIO DE SALUD DE HONDURAS. Elías Elizardo Zelaya.

Es necesaria la implementación de la cultura del dato útil y oportuno para responder a los compromisos de salud de la población. A esta conclusión se llegó en el marco de la reunión anual del Consejo Directivo de la Organización Panamericana de la Salud (OPS) en Washington.

POR EUGENIO GUTIERREZ

La toma de decisiones en salud no solo requiere antecedentes de archivos sino un manejo estratégico de la información y uso de la evidencia disponible. Es indispensable la implementación de la cultura del dato útil y oportuno para responder a los compromisos de salud de la población.

Resulta esencial la inversión en los sistemas regulares de información sanitaria y no sólo en la tecnología sin dirección estratégica. Así declaró en Washington el Secretario de Estado en el Despacho de Salud de Honduras, **Elías Lizardo Zelaya**, en el marco de la reunión anual del Consejo Directivo de la Organización Panamericana de la Salud (OPS).

Refiriéndose a la importancia de los instrumentos de información georeferenciada generados en Honduras con apoyo de la OPS, dijo que *"esta importante herramienta de análisis nos ha servido para mejorar los niveles de acceso a los servicios de salud en Honduras."*

La propuesta del uso de los sistemas de información geográfica (SIG_epi) de Honduras y del Área de Análisis de Salud y Sistemas de Información (AIS) de la OPS está enfocada en la generación de información oportuna de múltiples dimensiones -social, política, salud, educación, recursos- que en forma simultánea permiten una mejor toma de decisiones basadas en evidencia científica y en las necesidades de la población.

Esos son instrumentos de apoyo al análisis estratégico conducente para que el país aplique las acciones inmediatas en planificación estratégica a fin de mejorar la calidad de vida y la detección y control oportuno de brotes y epidemias, dijo la máxima autoridad hondureña de salud.

Falta mucho camino por recorrer, pero aun los primeros ejercicios realizados en 2002 con el Área de AIS de la OPS ya contribuyeron significativamente para la determinación de las prioridades en la nueva contratación de personal de salud y la apertura de 114 centros de salud, donde mas necesitaba la población hondureña, especificó.

El número de 1800 médicos fue ampliado con la posterior contratación de 636, constituyendo así uno de los resultados tangibles del nuevo sistema georeferenciado al que se suma la incorporación de 600 enfermeras auxiliares, 127 enfermeras profesionales y 82 odontólogos, explicó el economista. Agregó que *"el crecimiento de la red de salud derivó en un aumento del 30 por ciento de las atenciones en lugares de alta postergación del país"*.

Por su parte, el gerente del Área de Análisis de Salud y Sistemas de Información Sanitaria de la OPS, **Carlos Castillo Salgado**, expresó que *"con el incremento en la accesibilidad de la red sanitaria hacia las áreas de mayor necesidad, el ministro de Salud de Honduras pudo generar políticas y programas que en poco tiempo incrementaron la atención a la salud y lograron una reducción estimada del 30 por ciento de la carga de enfermedad de la población desprotegida, abriendo los espacios para dedicar esfuerzos a la promoción de la salud."*

La nueva aplicación de SIG epi en el Ministerio de Salud ya ha generado la evidencia de soporte para considerar algunas importantes iniciativas de ley en Honduras. Las enfermedades como dengue, tuberculosis y la epidemia de violencia, se generan desde un mismo lugar y provienen de urbanizaciones no planificadas.

El sistema georeferencial permite identificar con claridad el problema y tener un sustento para hacer propuestas, pues la ley se debe basar en la evidencia para lograr reducir las brechas de equidad en salud, subrayó Zelaya.

Los cinturones de miseria han impulsado al gobierno central y a los alcaldes a decidir sobre dotar a esos centros poblacionales de alumbramiento eléctrico, servicios sanitarios y centros de salud. La carencia de tales elementos crea condiciones adversas que generan desintegración familiar. Otra decisión es no permitir el continuo crecimiento de estos cinturones y establecer los correspondientes mecanismos de control, expresó.

Dijo que la acción concertada de alcaldes y del gobierno central redunda en decisiones más equilibradas. *"Contar con información confiable y oportuna -recalcó- es indispensable para vincular las relaciones entre escolaridad y mortalidad infantil. Una madre más educada puede generar mejores condiciones saludables para ella y su familia"*.

Hay que actuar en varios campos sociales y económicos, disponiendo de un mapa de mortalidad infantil y otro de escolaridad de madres. La mortalidad resulta más elevada cuanto menor sea el grado de escolaridad. Por eso aparece como fundamental la intervención del sector educacional, quien siempre es un aliado inseparable del sector salud, finalizó el Secretario de Estado en el Despacho de Salud de Honduras. ◆

STATEMENT OF OWNERSHIP, MANAGEMENT AND CIRCULATION

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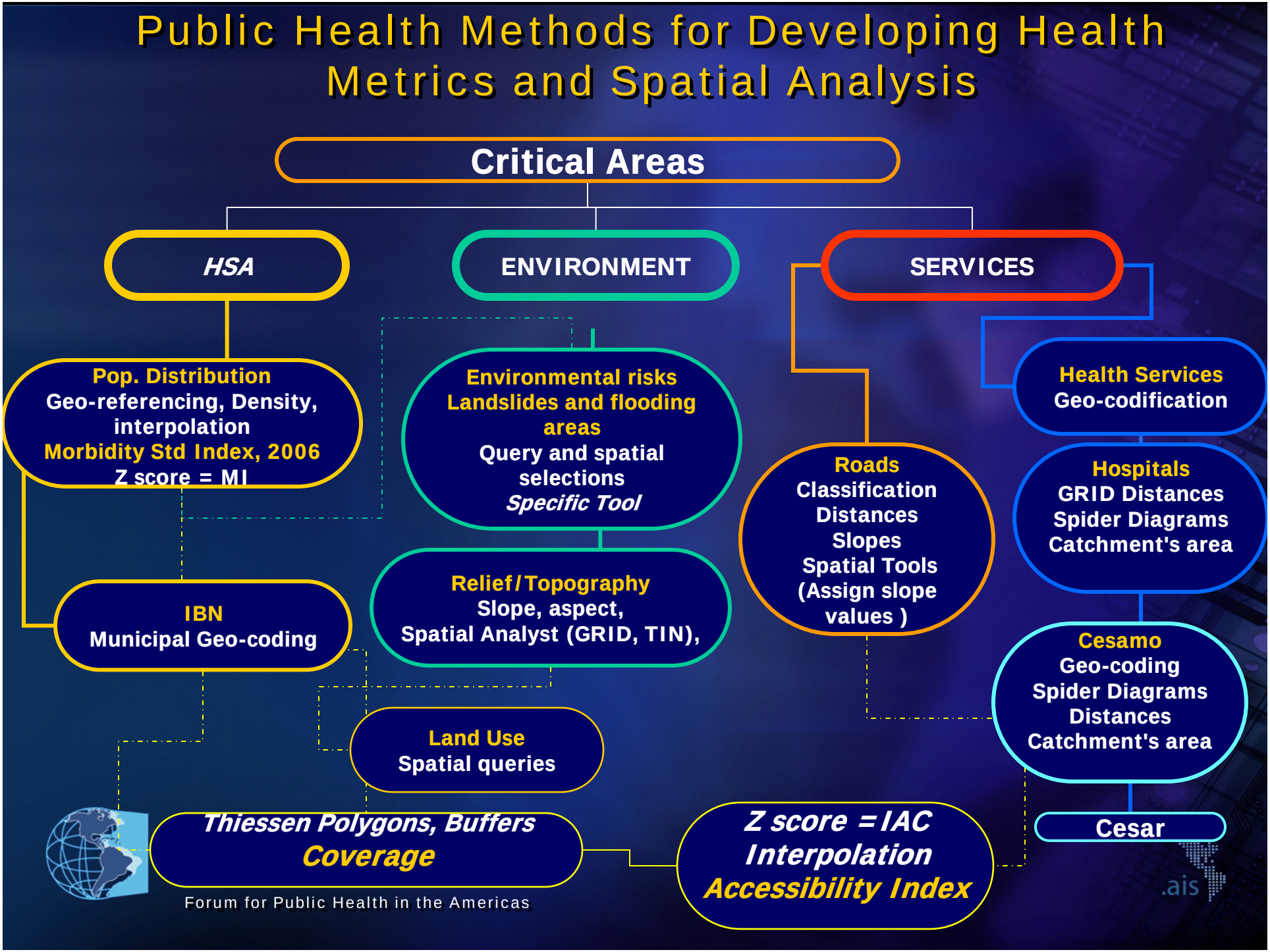
	(4) Other Classes Mailed Through the USPS	7	7
15c	Total Paid and Requested Circulation (sumof 15b(1),(2),(3) and (4)	495	533
15d	Free Distribution by Mail(Sample, Complementary, and other Free) (1)Outside County as Statedon Form 3541 (2) In-Countyas Statedon Form 3541 (3) Other Classes Mailed Through the USPS	243	243
15e	Free Distribution Outside the Mail(Carriers or Other Means)	10,941	12,512
15f	Total Free Distribution (sumof15d and 15f)	11,184	12,755
15g	Total Distribution (sum of 15c and 15f)	11,679	13,288
15h	Copies not Distributed	342	340
15i	Total (Sum of 15g and 15h)	12,021	13,628
15j	Percent Paid and/or Requested Circulation (15c divided 15g times 100)	4%	4%
16	Publicationof Statement of Ownership. Publication Required		
17	Signature and Title of Editor, Publisher, Business Manager		

Public Health Methods for Developing Health Metrics and Spatial Analysis



OUTLINE

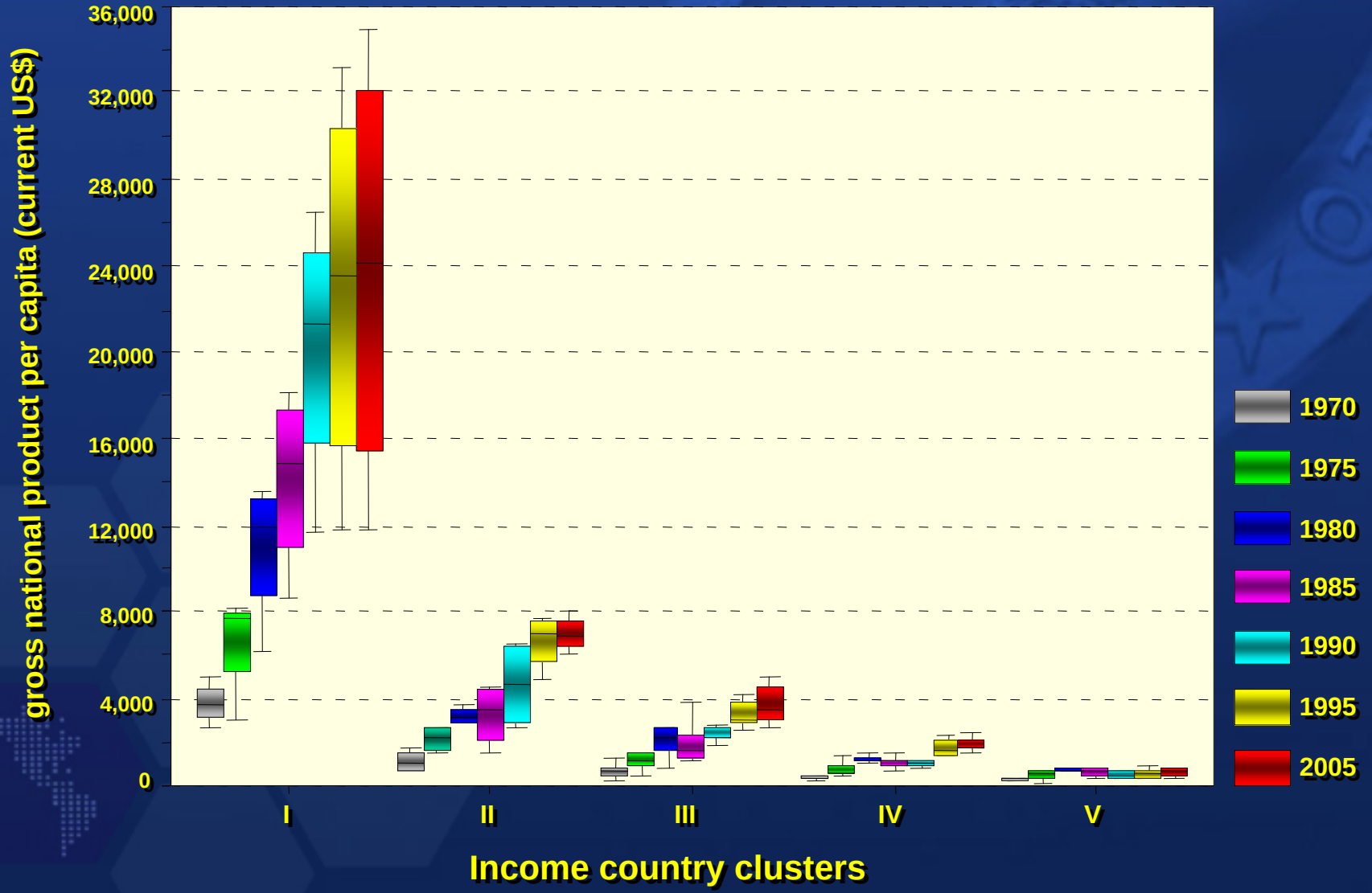
- Brief History of PAHO
- Developing a GIS-Epi Model
- GIS-Epi Applications
- Challenges of Global Public Health
- Next Steps

Changing Public Health Context

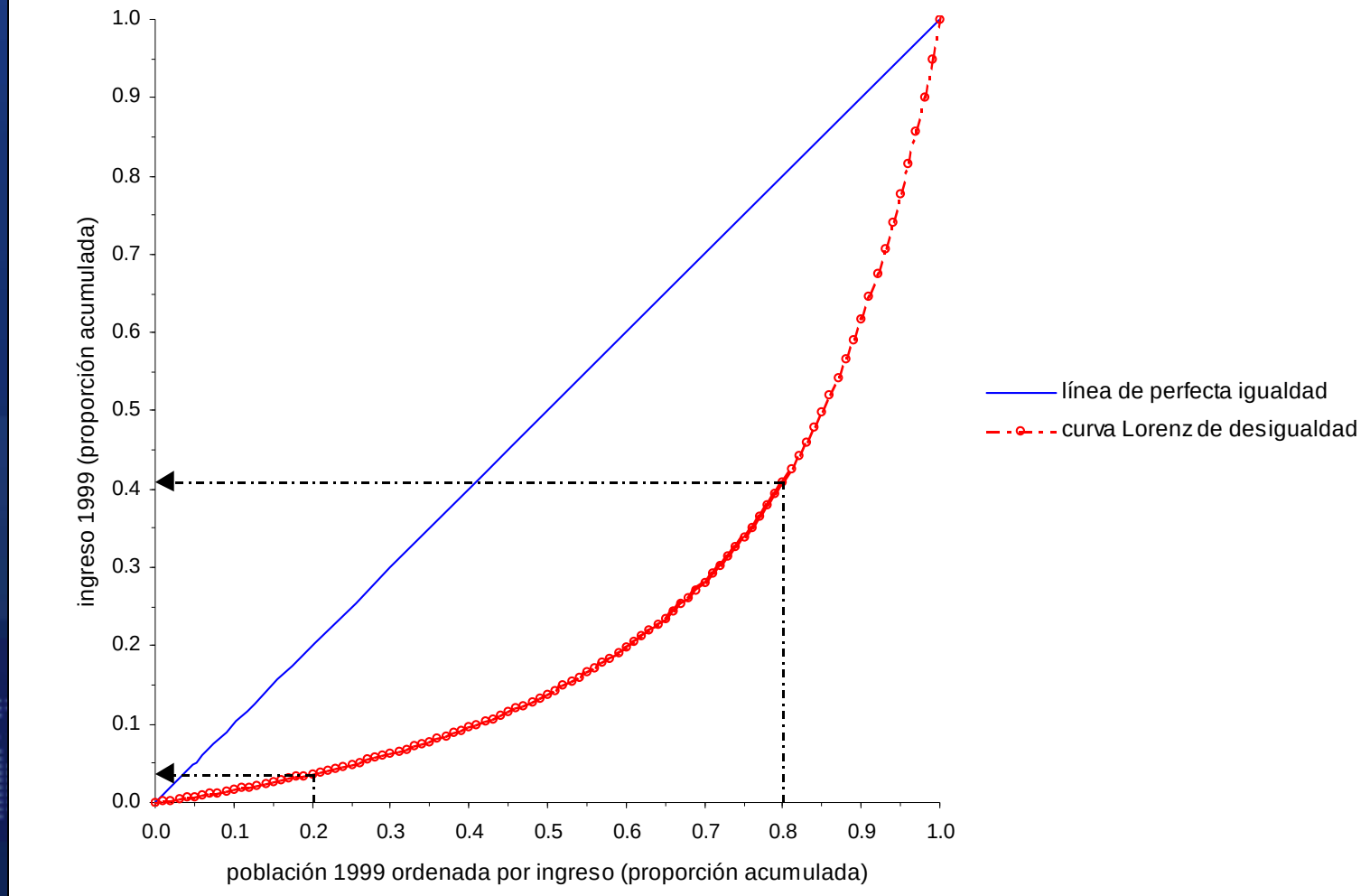
Global Issues

- **Globalization**
- **Bioterrorism**
- **Changing environment and natural disasters**
- **Increase solidarity in response to health inequalities. Reducing the health gap**
- **Epidemiological Polarization**
- **Recognition of health as an essential factor for development**

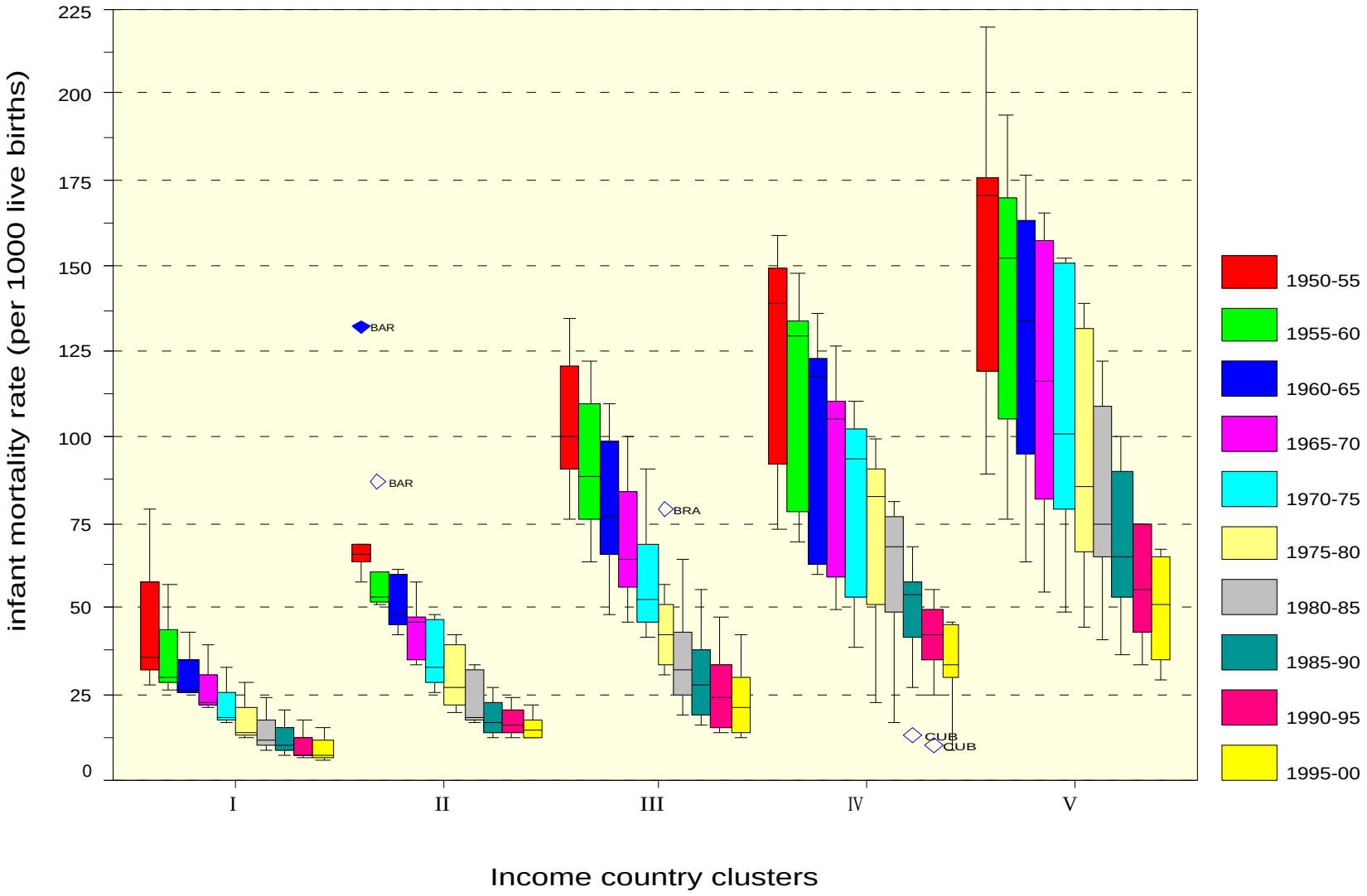
Gross National Product (GNP) per capita trends in The Americas by income country clusters, 1970-2005



Inequality in Income Distribution. Region of the Américas, 2000



Infant Mortality Trends in the Region of the Americas by Income Country Clusters; 1950-2005.



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Developing New Metrics for Public Health

- Equity in Health, MDG's and Globalization represent major challenges for the public health and global health of the 21st Century
- Sound information and analyses are essential for achieving healthy people/healthy spaces goals: tracking progress; evaluating impact; attributing change to interventions; and take decisions on public health programs focus and scope
- Too many uncoordinated demands for information; too much useless data

Next Steps

- The development and use of **new basic synthetic metrics** with spatial dimensions facilitates the analytical process of public health, allows for the identification of population clusters of areas in less favorable conditions and, through this, orienting the formulation of responsible health plans and programs.
- It is recommended the promotion of the collection and use of disaggregated information at the sub-urban level within municipalities

Needs for capacity building in GIS-PH

- Improved real-time global/regional public health surveillance
- Better targeting/focalization/stratification
- Improved response capacity
- Identification of health inequalities
- Monitoring of global health initiatives and mandates
- Orient decision-making and planning
- Evaluation of interventions and public health programs

Next Steps

- Increase the availability of consistent and reliable health data for determining population health distributions (not only national averages)
- Development of new Public Health Surveillance Systems using GIS
- Increase the efficiency of global public health cooperation building strategic collaborative networks with the academic, scientific and private sectors

Next Steps

- Moving from thematic mapping to public health analytical assessments
- Expanding regression and analytical tools such logistic regression models linked to geographically weighted models.
- Linking Multilevel Analyses with Robust GIS/Spatial Analytical tools
- **Closing the Public Health Know-Do Gap**

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