

## **CITY OF RIO DE JANEIRO - MAPPING DENGUE'S OCCURENCES**

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### **Technical topic - GIS and Digital Mapping**

**Abstract:** This paper describes the use of digital cartography associated to GIS technology, applied to a public health program of the Municipality of Rio de Janeiro, Brazil.

Considering the difficulties in managing the Dengue Eradication Program - a disease present as an endemy in the municipality, since 1980 - the Epidemiology Coordination of the Public Health Municipal Secretariat (SMS) decided that both the planning and the vector combat operations would be more efficient with the geographic spacialization of the information it supervised.

Therefore, a conjoined initiative was developed between SMS and Geographic Information Directory of the Municipal Urbanism Institute "Pereira Passos" (IPP/DIG) which resulted in the EPIGIS System. The system integrates all the necessary data for the disease control, using as its main information resource the mapping of that data onto the municipal digital cartography.

### **Historic**

The Geographic Information Directory of the Municipal Urbanism Institute "Pereira Passos" (IPP/DIG) is in charge of cartographic digital map of Rio de Janeiro City and for the development and dissemination of geoprocessing technology in this field with others agencies.

The goal is to use the digital cartographic base as a support to integrate of geographic data from different information systems, allowing to improve system witch relate the geographic characteristics and alfa-numeric data.

The application of Geographic Information System (GIS) technology is large because the most of data systems from City Hall administration have address identification as an important requirement to understand the hole municipality process.

The Epidemiology Department of the Public Health Municipal Secretary (SMS) manage information data of infection disease control and vital statistic, those information are the base of monitor of health programs performance.

The Eradication Program of *Aedes aegypti* in Brazil was released in 1996 by a Health Ministry giving a management role to the Municipal Secretary of Health in order to respect the principle organization of the Brazilian System of Health.

Until that the Secretary of Health did not have enough information about the Vector Program Control of which action was executed by t by the Geography and Statistics Brazilian Institute (IBGE) he National Health Foundation-Health Ministry (FUNASA-MS).

### **Disease**

Dengue is an acute viral disease transmitted by the mosquito *Aedes aegypti* bite, and is considered the most important arboviruse which caused human disease and a seriousness world health problem.

It has been causing epidemics since the begin of the century and remerged in Rio de Janeiro City in 1986 and had begun endemic with epidemics peak, which occurred in 1998-99, 2000-01, 2002, 2009, showing remarkable season ability from march to June with and low case fatality rate.

### **Digital Cartography**

The city of Rio de Janeiro has 1.250 km<sup>2</sup> of area, 6 million inhabitants, subdivided administratively in 34 regions, 157 districts, with approximately 22.000 streets and more than 2 millions of properties.

The existing digital cartography of the city, in 1:2.000 scale, covers 100% of the urban area of Rio de Janeiro City mapped with a high detailing level, (approximately 300 layers of information).

It also makes use of a set of color 1:10.000 scale ortophotos, dated of 1999, that they all cover the city, providing an appealing interface, with a wealth of detail much greater than what traditional maps can supply. Using this material a vectorial digital map in the same scale was confected, destined to the urban macro-planning and has a digital mapping in 1:1.000 scale for the areas of bigger urban density representing the great number of existing low income population habitations in the city.

The municipality digital cartographic mapping cadastral scale was implanted in modules. It is today complete and up to date. In 1997, 700 km<sup>2</sup> of the city urban surface had been produced and, in the year of 2000, the remaining 340 km<sup>2</sup> of the urban area, besides a set of ortophotos in the 1:2000 scale.

All these data are essential and basic resources for existence of a GIS. Detailed identification of streets and parcels and buildings numbers allow to locate in the map any event using the addressing as reference. Each layer of information acquires a bigger spatial dimension using topological concepts as proximity and pertinence in spatial analysis.

To use the mapping of the city in a geographic information system, aiming at carrying out the management of several data and events, is the best way of keeping it permanently up to date.

### **The Geographic Information System - EpiGIS**

## **Monitoring Vector Control Program And Dengue Disease**

The geographic base and difficulties to manager the health program led the search for a use of GIS technology by a conjoined with The Geographic Information Directory of the Municipal Urbanism Institute “Pereira Passos” (IPP/DIG) and Epidemiologic Department of Health Municipal Secretary.

The system was developed in order to be able to represent geographic information about dengue disease and vector control in Rio de Janeiro City.

### **Technical solution**

A System was developed to support the planning of actions to control and prevention dengue disease, through the geographic position of the dengue surveillance service informations and the vector control service.

The EpiGIS SIG implemented is an database integrator able to operate spatially and numerically data of the diverse systems of information that interact with the Epidemiologic Vigilance, offering in the same operational environment the possibility of construction of maps and/or charts and/or queries, related to the data associated to the system. Initially, the EpiGIS will integrate data from the following sources:

- Infections diseases report from the Nacional Information System (SINAN), from the Infection Disease Surveillance Service;
- Yellow Fever and Dengue Information System (FAD), from the National Health Foundation;
- Mortality Information System – deaths, (SIM), from the Epidemiologic Information Department;

The EpiGIS makes possible the geographic location of: address of dengue´s incidence, squares with positive focus and deposits with larvae of the mosquito, besides the environment conditions that contributes to the illness.

The SIG was developed to integrate information of the illness integrating in one environment all the available data to the control of the dengue, what allows the accomplishment of an integrated follow up of the actions, using as main feature the information plotting in the digital mapping of the city.

The geographic locate of the occurrences and the activities of vector control, *Aedes Aegypti*, associated to demographic and environmental informations, available in the Geography and Statistics Brazilian Institute (IBGE) mapping, will assist the composition of spatial analysis about the places of occurrence of the illness.

### **Searches offered by EpiGIS are exemplified above:**

Maps generated from the existing data in the databases associates to the System:

- spatial distribution of the cases of dengue, as shown in the Figures 1-3;
- identification of the squares by the health agents within the actions of the vectors control;
- identification of the squares with positive focus of vectors;
- identification of the areas of concentration of cases of dengue and/or vectors of the *Aedes*;
- cases of dengue by address overlapped with the squares covered by the actions of vector control;

Storage and search of geographic information and aggregate data:

- planning areas, administrative regions and districts;
- municipal health centers, hospital and basic health units;
- tax sectors - social and economical data - demographic, sanitation and income;
- urban equipment accessibility.

Production of tabular reports as

- illness and diagnostic confirmation;
- occurrence of the dengue by age group;
- occurrence of the dengue per month;

Charts production from the tabular data as, for example:

- classic and hemorrhagic cases of dengue, per month;
- classic, hemorrhagic and death cases of dengue, per year;

Spatial analysis:

- Identify areas to act in the vector control to the dengue as result of the analysis of several variables introduced through the system;
- Spatial distribution of reported cases of dengue per homes or per squares in the city of Rio de Janeiro;
- Spatial distribution of the infestation of vectors in different regions of the city;
- Identify areas of environmental exposure and population groups submitted to risk situations of dengue;
- Analyze overlapping situations of environmental and populational risk by factors correlated to dengue;
- Plan the actions and the action areas to be undertaken in the dengue control vector;
- Correlation between the notified cases of dengue and the attended areas by the actions of vectors control;
- Evaluation of the actions effectiveness of vector control;
- Systemic analysis to understand the standard causes of the illnesses within different environmental contexts;
- Spatial analysis of the illnesses to evaluate its relations with environmental, social and economical variables, allowing the adoption of actions of integrated planning aiming at the eradication;
- Application of geographic concepts to locate and manage health services.

### **Conclusion**

The system was designed in a modular form and the next functionalities will allow to process separated or aggregately all the available information. The control and follow up the results of laboratory in order to confirm the case will allow the complete surveillance of the occurrences, helping to prevent and to detect the disease in the City. The data from both systems FAD and SINAN must be analysed together in order to take right decision.

The management of the program control demands the use of social political, and geographical information bringing out the wickedness, leading to the better solution.

This experience shows that the application of geographic concepts adds a new dimension to the epidemiological control, making it possible to understand the patterns of the causes of the disease, within specific environmental context, through a systemic analysis. This scenario perception will contribute on the identification of demands of the specific regions of the city, and guide the development of new actions and policies concerning the Public Health in the Municipality of Rio de Janeiro.

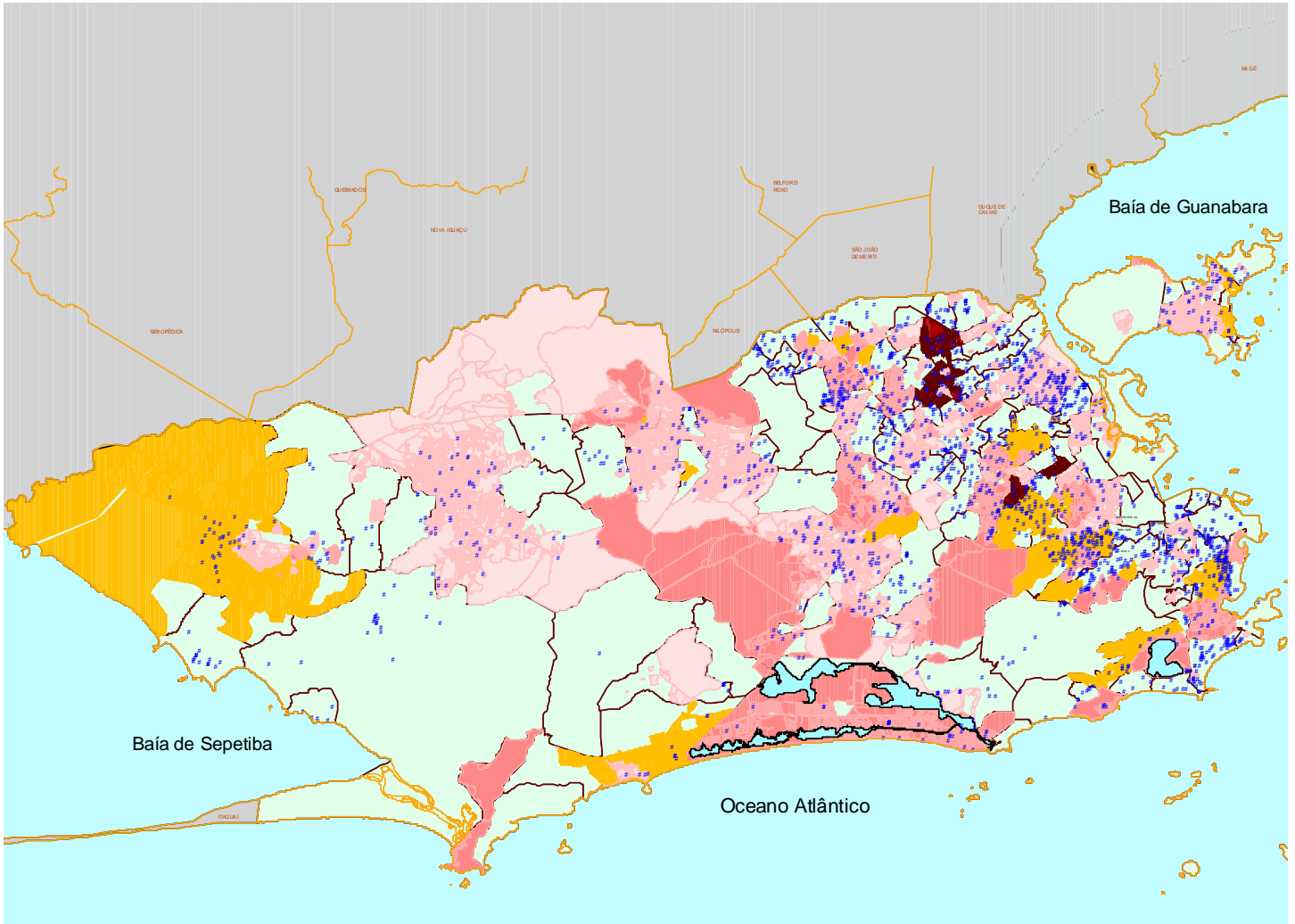


Figure 1 – City of Rio de Janeiro, Brazil – 2001 – dengue’s occurrences versus infestation index

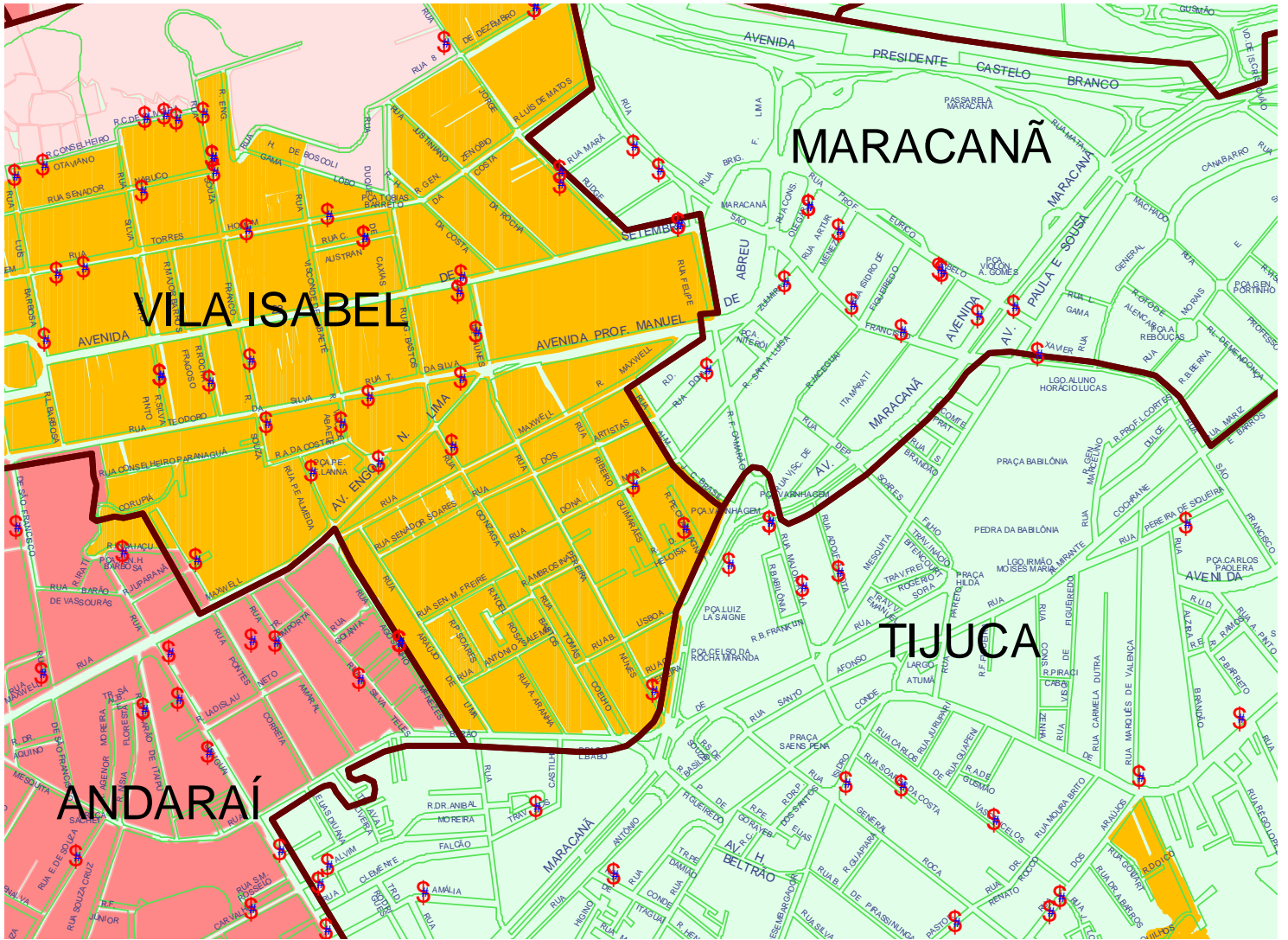


Figure 2 – City of Rio de Janeiro, Brazil – 2001- dengue’s occurrences by address versus infestation index by square

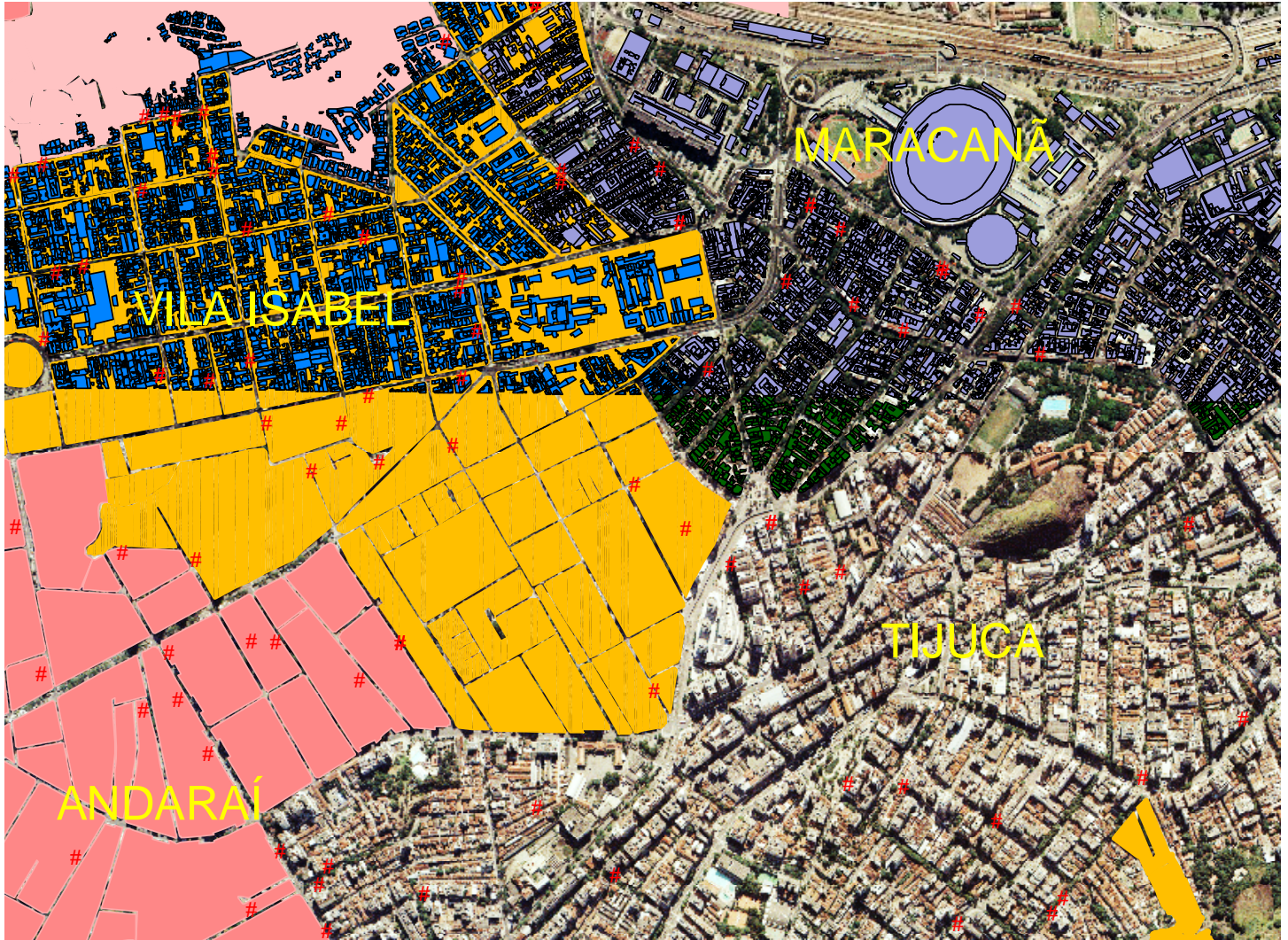


Figure 3 – City of Rio de Janeiro, Brazil – 2001 – dengue's occurrences by address versus infestation index by square -- orthophoto

**BIBLIOGRAPHY**

1. Medronho, A. R. Geoprocessamento e saúde : uma nova abordagem do espaço no processo saúde doença. Rio de Janeiro : Fundação Oswaldo Cruz, 1995.
2. Teixeira, Maria da Glória; Brreto, Maurício Lima; Guerra, Zouraide. Epidemiologia e medidas de prevenção do dengue. **Informe Epidemiológico do SUS** 1999, 8 (4): p.3-33.
3. Rojas, Luiza Inígnez; Barcellos, Christovam; Peiter, Paulo. Utilização de mapas no campo de epidemiologia no Brasil : reflexões sobre trabalhos apresentados no IV Congresso Brasileiro de Epidemiologia. **Informe Epidemiológico do SUS** 1999, 8 (2): p.27-35.
4. Rio de Janeiro. Prefeitura da Cidade do Rio de Janeiro. Plano Municipal do Aedes Aegypti. Rio de Janeiro : Prefeitura, 1997.
5. Brasil. Ministério da Saúde. Fundação Nacional de Saúde. Manual de dengue – vigilância epidemiológica e atenção ao doente. 2.ed. Brasília : Departamento de Operações. Coordenação de Controle de doenças transmitidas por vetor, 1996.
6. Brasil. Ministério da Saúde. Fundação Nacional de Saúde. Instruções para pessoal de combate ao vetor : manual de normas técnicas. Brasília : Secretaria Executiva. Plano Diretor de Erradicação do Aedes aegypti do Brasil, 1998.
7. Universidade Federal de Santa Catarina. Laboratório de Ensino à Distância. Dengue operações básicas. Florianópolis : LED, 1998.
8. Rio de Janeiro. Fundação Oswaldo Cruz. Epidemiologia : 3<sup>o</sup> Plano Diretor para Desenvolvimento da Epidemiologia no Brasil. Rio de Janeiro : Associação Brasileira de Pós-Graduação em Saúde Pública (ABRASCO), 2001.
9. Brasil. Rede Interagencial de Informações para a Saúde (RIPSA). Relatório da 1<sup>a</sup> reunião do Comitê Temático Interdisciplinar de Dados Espaciais em Saúde. Brasília : RIPSA, 1999.
10. Brasil. Rede Interagencial de Informações para a Saúde (RIPSA). Sistemas de Informação Geográfica e a Gestão da Saúde no Município. Brasília : RIPSA, 1999.
11. Camargo Jr., K.R., COELI, C.M. RECLINK : Aplicativo para o relacionamento de bases de dados implementando o método *probabilistic record linkage*. In: **IV CONGRESSO BRASILEIRO DE EPIDEMIOLOGIA**, 1998, vol.1: p. 162.
12. Noronha, Cláudio Pompeiano; Silva, Rosanna Iozzi; Theme Filha, Mariza Miranda. Concordância de dados das declarações de óbitos e de nascidos vivos para a mortalidade neonatal no Município do Rio de Janeiro, 1997, 6 (4): p. 57-65.