

# APPLICATIONS OF GEOGRAPHIC INFORMATION SYSTEMS IN PUBLIC HEALTH

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**Abstract:** Known as GIS (Geographic Information Systems), these instruments of storage, analysis and visualization of spatial data represent an area with a spectacular development. I aimed at a Geographic information system in order to represent certain data and public health indicators at the level of the county of Bihor and to present the experience gained for the improvement of the use of GIS in the management of public health in Romania. I realized a GIS project for public health with indicators regarding the county of Bihor, encompassing the following types of data and indicators: demographics, economy data, morbidity data, health services in relation to the Health Insurance House of the county of Bihor. The data were analyzed and included in maps with SIGEpi and ArcMap 9.2. software. The maps produced have the following themes: population density, infant mortality, marriages and divorces, number of households per city, size of water and gas networks and sanitation in each locality, the number of economically active units per 1,000 inhabitants, coverage with primary care services (family medicine, dentistry and pharmacy) in 2004 and 2007, identification of areas without one of the three types of primary health care services (family medicine, dentistry or pharmacy) in 2007. The application of GIS allows the improvement of public health in correlation with the National Strategy for Public Health, Law no. 95/2006 and the laws regarding the National Public Health Programmes. The effective implementation of GIS regarding public health in Romania will also require new legal regulations (Order of the Ministry of Health), training of the health staff regarding the use of the GIS. After the initial steps, a new organizational structure (at national or sub national level) will be necessary in order to establish GIS norms and procedures and to corroborate the collected data at county level.

**Keywords:** Geographic Information Systems, GIS, public health, health indicators, health services

**Rezumat:** Cunoscută sub denumirea de GIS (Geographic Information Systems - sisteme informatice geografice SIG) aceste instrumente de stocare, analiză și vizualizare a datelor spațiale constituie un domeniu cu dezvoltare spectaculoasă. Mi-am propus unui sistem informatic geografic pentru reprezentarea unor date și indicatori de sănătate publică la nivelul județului Bihor și prezentarea experienței dobândite pentru creșterea utilizării

sistemelor informatice geografice în gestiunea sănătății publice din România. A fost realizat un proiect de sistem informatic geografic pentru sănătatea publică cu date și indicatorii privind județul Bihor, grupate în următoarele categorii: demografici, date economice, date de morbiditate, date privind serviciile de sănătate în relație cu CASJ Bihor. Datele au fost analizate și incluse în hărți cu aplicațiile informatice SIGEpi și ArcMap 9.2. Hărțile obținute au următoarele teme: densitatea populației, mortalitatea infantilă, nupțialitatea și divorțialitatea, numărul de locuințe pe localități, mărimea rețelelor de apă, gaz și canalizare în fiecare localitate, numărul unităților economice active la 1000 locuitori, acoperirea cu servicii de asistență primară (medicină de familie, medicină dentară și farmacii) în anii 2004 și 2007, identificarea localităților în care nu există unul din cele trei tipuri de servicii de asistență medicală primară. Aplicarea SIG oferă posibilități de îmbunătățire a sănătății publice legat de aplicarea Strategiei Naționale de Sănătate Publică, Legii nr. 95/2006 și legislației privind Programele Naționale de Sănătate. Implementarea efectivă a SIG în sănătatea publică din România mai necesită elaborarea unui act normativ (ordin al Ministrului Sănătății), instruirea personalului privind utilizarea SIG iar ulterior existența unei structuri organizaționale (naționale sau regionale) care să stabilească proceduri și standarde în domeniu și să coroboreze datele colectate de la nivel județean.

**Cuvinte cheie:** sisteme informatice geografice, S.I.G., sănătate publică, indicatori de sănătate, servicii de sănătate.

## INTRODUCTION

As the sources of information are multiplied worldwide and our lives are more and more affected by global events, the request for the Geographic information is increasing. Geography tools can provide answers to health problems related to the prevention and control of the communicable and non-communicable diseases.

Nowadays, the decisions of the governmental, non-governmental and business organizations are based on "spatial data" (Geographic data). Some authors think that more than 75% of an organization's data contain a spatial component (infrastructure locations, the location of customers or beneficiaries, components of activities

etc.).

Known as GIS (Geographic Information Systems), these instruments of storage, analysis and visualization of spatial data represent an area with a spectacular development. The specific operations of GIS on spatial data turn these systems not only into effective tools for viewing multiple data in the form of maps, but mainly into instruments for analyzing the information regarding the land area. Existing data can be reused, as one of the major goals of GIS is an effective management and update of the data.

The questions that can be answered by a GIS updated with the appropriate data are questions used, both in public health and in the sanitary management:

- “What is at ...?” which is the situation of a demographic indicator, prevalence/incidence by a disease or a group of diseases in a given Geographic area (village, town, city, local territory, county, development region, country, continent);
- “Where is ...?” is the opposite of the previous question and requires spatial analysis. By answering this question, within a GIS we can find out, for example, where is located the nearest health unit with beds or ambulance station in a given place, which are the places with the worst indicators of health status, where is the best access to the primary medical services (family medicine, dentistry, pharmaceutical assistance);
- “What has changed since ...?” - a question that may involve the two previous questions, determining changes in time that occurred in a given area.
- “What space model is there?” the question seeks an answer to a complex issue related to the existence of health problems in the proximity of a risk factor (chemically polluted water, nuclear plant etc.).
- “What if there were built ...?” is a question put in order to determine what environmental phenomena could occur in case of a road construction, what would lead to the construction of a new health institution in a given area, what would be the effect of pollution on groundwater etc.

### PURPOSE OF THE PAPER

Application of a Geographic Information System to present public health data and indicators for the county of Bihor and the presentation of the experience acquired to increase the use of the Geographic Information Systems in the public health management of Romania.

#### Objectives:

- to acquire skills for drawing up a Geographic Information System project for public health, using ArcGIS and SIGEpi software;
- to analyze the health information system at regional level;
- to establish a set of data and indicators in order to be included in the Geographic Information System;
- to create the Geographic Information System for the county of Bihor;
- to present the results;

- to extrapolate the experience gained by drawing up a health programme, a curriculum of training through sustained medical education of the public health professionals and to make proposals for legislative changes.

### MATERIAL AND METHOD

I aimed at accomplishing a project of Geographic Information System for public health, with data and indicators regarding the county of Bihor, grouped in the following categories: demographics, economy data, morbidity data and health services in relation to the Health Insurance House of the county of Bihor.

Three databases have been created: “general data”, “cancer data”, “data of the Health Insurance House of the county of Bihor”. The sources of information used were: the Statistical Year Book of the county of Bihor (for the demographic and economy data), the Cancer Registry of the county of Bihor (for the morbidity data) and the Health Insurance House (for the health services data). The data were analysed and included in maps with the help of SIGEpi and ArcMap 9.2 software.

**Picture no. 1 - Administrative-territorial units of the county of Bihor (2007)**



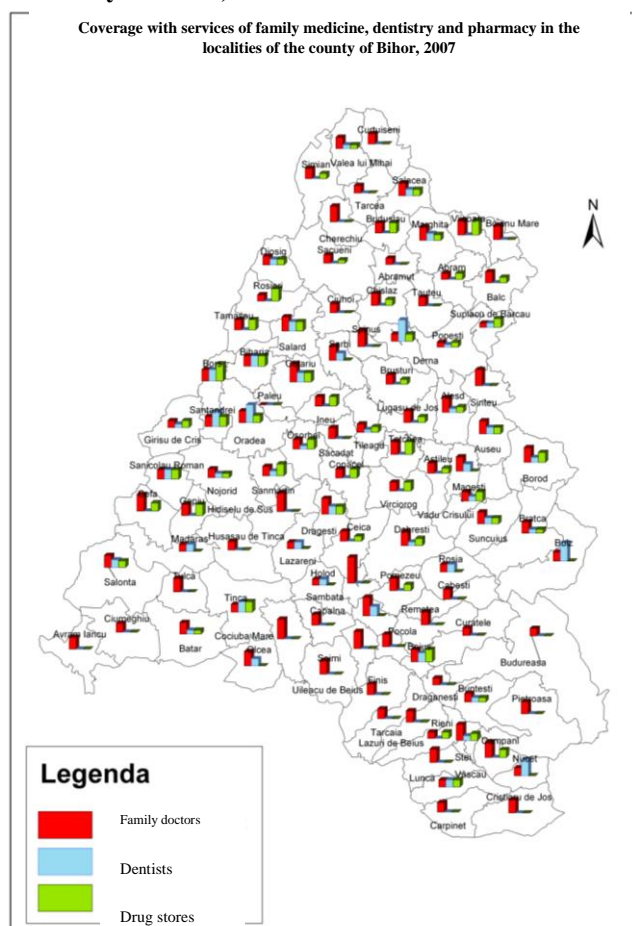
### RESULTS AND DISCUSSIONS

The results of GIS application for public health in the county of Bihor brought about to the accomplishment of

certain maps with data, at the level of the administrative-territorial units and to the presentation of the following themes:

- population density,
- infant mortality,
- marriages and divorces,
- number of households per city,
- size of water and gas networks and sanitation in each locality,
- the number of economically active units per 1,000 inhabitants,
- coverage with primary care services (family medicine, dentistry and pharmacy) in 2004 and 2007 (Map 2),
- the identification of areas without one of the three types of the primary health care services (family medicine or dentistry or pharmacy) in 2007.

**Picture no. 2 - Coverage with services of family medicine, dentistry and pharmacy in the localities of the county of Bihor, 2007**



### CONCLUSIONS AND PROPOSALS

GIS application for the data used in public health allows the access to a friendly method of work, as well as the visualization of the results of the activity in an easy to understand manner for the large public, too. The dissemination of the obtained maps, including through the

Internet, allows the empowerment of the public health services beneficiaries and the facilitation of the decision making process, based on the territorial repartition or on the pattern of the analysed phenomena.

Including the Geographic Informational System in the Romanian health legislation gives the possibility of improving public health, in relation to the application of the Public Health National Strategy, to the Law no. 95/2006 and on the legislation on the National Health Programmes.

The effective implementation of the GIS in the Romanian public health still requires the elaboration of a legal act (Order of the Minister of Health), the training of the health personnel in the use of GIS and subsequently, the existence of certain organizational structures (national or regional), which should establish norms and procedures in the field and to corroborate the collected data at county level.

### BIBLIOGRAPHY

1. Marcu A. Metode utilizate în monitorizarea stării de sănătate publică-Institutul de Sănătate Publică București, 2002.
2. Vulcu L. Sănătatea este un bun economic-Editura Universității "Lucian Blaga" Sibiu, 2005.
3. Enăchescu D. Marcu MG. Sănătate Publică și Management Sanitar-Editura All, 1998.
4. Dahlgren & Whitehead. Health Inequities, [http://www.health-inequalities.org/bot\\_Seite184.html](http://www.health-inequalities.org/bot_Seite184.html) -accesat 23 decembrie 2006.
5. [www.who.int](http://www.who.int)-accesat la 23 martie 2008.
6. Ministerul Sănătății. Strategia Națională de Sănătate Publică-Ed.Herris, Suceava, 2004.
7. Dimitriu G. Sisteme informatice geografice GIS-Editura Albastră, Cluj Napoca, 2001.
8. Basic of making maps, <http://webhelp.esri.com/arcgisdesktop/9.1/> -accesat 23 decembrie 2006.
9. [www.mapmaker.com](http://www.mapmaker.com)-accesat 24 martie 2008.
10. Băduț M. Sisteme informatice geografice – fundamente practice, Editura Albastră, Cluj-Napoca, 2004, p.23-24.
11. [www.esri.com](http://www.esri.com)-accesat 24 martie 2008.
12. Csiki IE, Marcu A, Ungurean C. Descrierea Sistemului Național Informațional de Sănătate din România. Institutul de Sănătate Publică București, 2003.
13. Neuron. Seminarul „Sisteme Informatice Geografice Utilizate în Gestiunea Teritoriului”, Cluj-Napoca, 2006. <http://www.cjcluj.ro/UserUploadedFiles/File/prezentari%20gis/Prezentari%205%20oct%20neuron/prezentare%20112.ppt>, accesat: 14.03.2008.
14. Gâlea D, Frâncu C, Ocheșel A. Harta electronică pentru asigurări de sănătate-Caiet de rezumate, Conferința Managementul Informației și Informatizarea Sistemului de Sănătate, Iași, 2004:18.
15. North American Association of Central Cancer Registries. Using Geographic Information Systems Technology in the Collection, Analysis, and

Presentation of Cancer Registry Data: A Handbook of Basic Practices, October 2002, <http://www.schs.state.nc.us/NAACCR-GIS/GISHandbook20030603.pdf>-accesat 23 martie 2008

16. Abdel-Aty M, Chundi SS, Lee C. Geo-spatial and log-linear analysis of pedestrian and bicyclist crashes involving school-aged children.-J Safety Res. 2007;38(5):571-9. Epub 2007 Oct 22.
17. Borrell LN, Northridge ME, Miller DB, Golembeski CA, Spielman SE, Sclar ED, Lamster IB. Oral health and health care for older adults: a spatial approach for addressing disparities and planning services.-Spec Care Dentist. 2006 Nov-Dec;26(6):252-6.
18. Williams CJ, Willocks LJ, Lake IR, Hunter PR. Geographic correlation between deprivation and risk of meningococcal disease: an ecological study. BMC Public Health. 2004 Jul 26;4(1):30.
19. Susi L, Mascarenhas AK. Using a Geographic information system to map the distribution of dentists in Ohio.-J Am Dent Assoc. 2002 May;133(5):636-42.
20. Rushton G. Public health, GIS, and spatial analytic tools.-Annu Rev Public Health. 2003;24:43-56. Epub 2002 Oct 23.
21. Kamadjeu R, Tolentino H. Web-based public health geographic information systems for resources-constrained environment using scalable vector graphics technology: a proof of concept applied to the expanded program on immunization data. Int J Health Geogr Jun 2006;(3):5:24.
22. Edelman LS. Using geographic information systems in injury research.-J Nurs Scholarsh. 2007;39(4):306-11.