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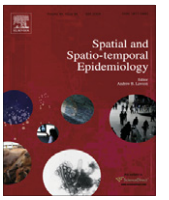

The interactive atlas on health inequalities

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ABSTRACT

In order to translate specialized scientific information into available, relevant and useful knowledge for decision-makers in public health, the PRIMUS group has developed the on-line Interactive Atlas on Health Inequalities (IAHI), based on user's needs assessments and data availability. Built on multidimensional tables, the IAHI is an health information system which has the power to allow users, especially those concerned by health inequalities, to query rapidly and interactively large volumes of health data (in aggregated format) at different spatial and population levels and to produce meaningful results displayed as tables, graphs or maps almost instantly. Designed explicitly to reveal inequalities in health, the IAHI offers relevant information for understanding social and geographical health inequalities observed for myocardial infarction, osteoporotic fractures, diabetes, chronic pain, schizophrenia, and mood disorders. The IAHI is a powerful support tool for decision-makers, serving the long term goal of closing the gaps across sub-populations, in terms of prevalence of diseases, access to health care, treatments and health outcomes.

1. Introduction

The term "health inequality" is used to designate differences, variations, and disparities in the health achievements of individuals and groups (Kawachi et al., 2002). Equity in health is one of the basic values that guide the Pan American Health Organization (PAHO, 2001), also recognized by Barbara Starfield in her statement: "An important goal is to minimize the disparities across population subgroups so that certain groups are not at a systematic disadvantage with regard to their access to health services and achievement of optimal health" (Starfield, 1998). Along the same lines, the Primus research group aims to provide decision-makers with comprehensive information on health-related problems to support evidence-based informed decisions.

The increasing burden of chronic diseases and mental disorders is a challenge in health management and planning and there is a need to reduce health inequalities (Romanow, 2002; Broemeling et al., 2008; Wagner, 2001). Many variations have been reported in health related issues in the population, such as incidence/prevalence of specific diseases, as well as for health care utilization, morbidity and mortality (Lalonde, 1974, Lemco, 1994, Raphael, 2000). According to national and international public health agencies and organizations, determinants of health can be related either to individual characteristics (such as gender, age, biology and genetics), to a health care system (health and social services) or to social and physical environments (such as neighborhood and transportation) (Wilkinson and Marmot, 2003; Starfield, 1998; Raphael, 2004). Researchers and decision-makers should use all available information, but it is often disparate and difficult to access and integrate it into meaningful knowledges. This is especially the case when considering the most deprived populations, which suffer the largest health inequalities in terms of diseases prevalence, treatments and health outcomes (PHAC, 2008).

On the other hand, it is well known that most health and human service problems facing the world today exist

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in a geographic context and any analysis must consider this context. In many regions of Americas, the availability of health information aggregated by geographical units generally permits the analysis of inequalities, which should serve as a basis for decision-making (PAHO, 2001). Therefore, the use of Geographic Information Systems (GIS), combined with statistical analyses, allows the decision-makers to understand the tendencies, correlations and interrelations between health, health determinants and the environment. Thus, GIS represents an excellent tool for accessing empirical information on populations within their real context. Indeed, using GIS is especially useful for policy-making in public health, such as priority-setting and resource allocation, monitoring and planning (Boulos, 2003; Gatrell and Löytönen, 1998; Meade and Earickson, 2000; Cromley and McLafferty, 2002; Maheswaran and Craglia, 2004, Williams et al., 2011). In the last decades, there has been a tremendous progress in geomatics and informatics, resulting in the development and improvement of health information systems, one of the most promising fields of research with significant benefits for medical statistics and epidemiology, and health care in general (Haux, 2006).

In the last decade, several health information systems have been developed and are available online. Despite the fact that these Atlases have a lot of advantages, too many often, the spatial analysis options are limited (administrative territories only), they offer minimal health indicators, or the possibilities of queries are limited to only one dimension.[1] Thereby, an online Interactive Atlas presenting a comprehensive set of health indicators related to the most important chronic diseases, and offering large possibilities of queries at a comprehensive set of spatial and population levels, might better fit the needs of decision-makers to assist them in their responsibilities of health monitoring, resource allocation, management and planning.

Since 2005, the PRIMUS research group has been leading population health research on geographical and social inequalities using ecological analyses with naturalistic cohorts for the study of chronic diseases and mental disorders. For the purpose of translating specialized scientific information based on their results into available, relevant and useful knowledge for public health decision-makers, the PRIMUS group has developed the Interactive Atlas on Health Inequalities (IAHI). The IAHI is an online easy-to-access health information system that allows users, and particularly those concerned by health monitoring, resource allocation and planning for chronic diseases and mental disorders, to interact with combined sets of data including administrative health information (in aggregated data format) and socio-geographical population information to acquire instantly meaningful results displayed as tables, graphs or maps.

[1] Atlas sur la santé et des services sociaux du Québec (http://www.msss.gouv.qc.ca/statistiques/atlas/atlas/index.php), Atlas Santé Montréal (http://emis.santemontreal.qc.ca/outils/atlas-sante-montreal/) Chronic Disease Infobase (http://204.187.39.30/Surveillance/Index.aspx?L=fra), Pennsylvania Cancer Atlas (http://www.geovista.psu.edu/grants/CDC/).

2. Methods

The completion of this project involved multidisciplinary expertises including epidemiology, mathematics, geomatics and computer sciences. The general scheme for the development of the IAHI is shown in Fig. 1. The project has been divided into five closely related steps: (1) Needs assessments, (2) General conceptual model, (3) Data acquisition, (4) Extract, Transform and Load (ETL) process and (5) User's interface.

2.1. Needs assessment

Needs assessments was completed to define functionalities as well as the expected information to be produced by the IAHI as expressed by potential users. These potential users include decision-makers and were affiliated mainly, but not exclusively, to governmental organizations such as the *Ministère de la santé et des services sociaux* (MSSS), the *Institut national de santé publique du Québec* (INSPQ), and the *Agences régionales de la santé et des services sociaux* (ARSSS). We also recruited people from non-governmental agencies, such as health related foundations, the pharmaceutical industry or community organizations that have neither the financial resources nor the expertise for acquiring the kind of information available from the IAHI. Users' needs were collected with individual interviews and focus groups. The discussions were focussed on health outcomes and analytical "filters" to measure health inequalities according to user's perspectives, which could be administrative, clinical or epidemiological.

The assessment allowed us to define (a) the specific populations of interest (such as age groups, gender and time periods); (b) the variables required regarding health outcomes information (such as incidence, treatments or prognosis), and (c) the geographical or social units of analysis, such as by administrative territories, by deprivation status and/or rural attributes of the neighborhood.

2.2. General conceptual model

Based on the needs assessment and data availability, we designed a general model for the IAHI (Fig. 2). This model included four main processes: (a) acquiring spatial, population and health data (inputs), (b) Extracting data, Transforming and Loading (ETL) aggregated data for the datacubes, (c) building datacubes to be queried with the JMap/SOLAP technology (outputs) and, (d) programming the IAHI online interface. Many topics involved in the development of the IAHI were selected and defined according to the needs assessment results and are related to six specific concepts: space, health indicators, time periods, gender, age and types of measures. These concepts provided the theoretical backbone that supports the six dimensions of datacubes.

Spatial dimensions provide eight specific entities as defined by (a) four scales of administrative territories, (b) a rural–urban classification of the neighborhood, (c) the quintile of material and social deprivation index of the