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The application of WHO's Health and Environment Geographic Information System (HEGIS) in mapping environmental health risks for the European region

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Abstract

The Health and Environment Geographic Information System (HEGIS) for Europe, which is being developed at the WHO European Centre for Environment and Health, will serve as a tool for the identification of 'hot spots' of environmental degradation and/or 'hot spots' of 'poor' health. Such a tool is useful as a basis for national and international actions, under the umbrella of the Environmental Health Action Plan for Europe, which aim at the improvement and/or prevention of these 'hot spots'. HEGIS is designed to show patterns in human health and trends in the exposure to recognized health hazards on the subnational level. This way the system contributes to the assessment of health risks based on known exposure-health relationships and reliable as well as compatible information collected by Member States. It can also be used to monitor the effects of policies on the improvement of the environment and health.

Keywords: Health and environment geographic information system; Environmental and health situational risks

Human presence is the centre of importance; people have a specific relation with the environment. It provides their physical living space, their food and materials and energy for their socio–economic system. The environment receives physical changes and pollution in return. Since the industrial revolution in the late 18th century, environmental contamination has increased steadily throughout the world—and radically during the last few decades. Of the 60–70 thousand chemicals used regularly only 5%, around 3000,

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make up 90% of the total volume. Around 200–1000 'new' chemicals are put on the market every year. Due to industrial and traffic emissions, agricultural use (pesticides and fertilizers) and disposal practices (industrial and domestic), many hazardous materials are discharged in such a way that they may consequently form a potential hazard to human health and the environment [1].

In order to meet the targets of reduction policies, numerous national and international organizations collect data on pollution and analyze the levels of pollutant emissions to different environmental media. Each country has a network for monitoring air, food, water and soil quality, to make sure that the current levels meet the national limit values or the guideline values. These values are the long-term reference used for the protection of human health. Data required to determine the state of public health e.g. life expectancy and cause specific mortality and morbidity are also widely available (see the Health for all targets compendium of indicators on national level collected from Member-States and revised each year by WHO Regional Office for Europe). The most difficult question is how to relate the health status of a population to the quality of the environment with the use of data on specific environmental pollutants. Another difficult task is to determine the significance of the pollution and to measure the respective impacts of different hazardous factors on health and well-being. A key item in this respect, specified by European Science Foundation, is the need for the development of an appropriate geographical information system (GIS), in order to establish methods for mapping the distribution of causes and effects of various environmental hazards [2].

Access to relevant information and the integration of such information into an information system is a critical component when trying to answer questions related to problems such as those mentioned above. GIS is considered to have a distinct added value for spatial and temporal analysis of environment and health problems. This technology has greatest potential as a tool for descriptive analysis as well as for graphical presentation of data and result, which could lead to new insights in possible relationships between environment and health. However, simple mapping of (relevant) data on environment and health does not automatically result in a sound assessment of environmental health risks. A major obstacle in the use of GIS for human risk assessment lies, on one hand, in the fact that people are mobile and during their life and work are subject to all kinds of exposure and to changing circumstances, which may lead to ambiguous effects. On the other hand, as stated in the introduction of the United Kingdom National Environmental Health Action Plan [3], there are many causes of ill-health which may inter-relate with one another and their effects may vary because of the particular circumstances of each individual, including the conditions in which they have been exposed to the 'cause'. Therefore, it is very difficult to identify a particular illness and state, with confidence, that it is principally caused by a particular condition of the environment. It is equally difficult to identify a particular environmental condition and state, with confidence, that it is the principal cause of a particular condition of ill-health. These difficulties may be reduced when there is severe pollution and obvious ill-health, but are greatly aggravated when people's exposure to a potential health hazard or combination of potential hazards is very low. The situation is even more complex when the mapping of environment and health data or risks are being compared, for example, between countries that usually have different ways of collecting and interpret-

ing data. These difficulties can be solved by monitoring both the state of the environment and that of the public health and to try, through epidemiological and other research, to improve our understanding of the effects of the environment on human health.

A similar idea put forward in the above-mentioned document, was the keystone for the development of the Health and Environment Geographic Information System (HEGIS) for Europe, being developed by WHO-ECEH since 1990. This system has two main aims:

1. geographic environmental monitoring and health surveillance;
2. health risk assessment and management of the main known environmental hazards.

It was assumed that, at European level, the environmental pollution impact on human health could be determined by extrapolating the results of epidemiological studies which have common conclusions, taking into account uncertainties and assuming the estimated population exposure exceeds the WHO guideline values [4].

One of the distinguished features of the system is spatial resolution for which demographic, health and environment information, when available, is collected on subnational (NUTS II–III) levels. The requirement for subnational data derives from the substantial variations in the population density, the health status of the population and the environmental exposure within the countries. This approach permits mapping of the situational risks of the population under exposure and the actual harm from hazardous factors knowing the ways in which exposure may occur, as well as, health–dose (effect) relationships. The identification of so-called 'hot spots' of environmental degradation and/or 'hot spots' of 'poor' health, serve as a basis for national and international actions, under the umbrella of the Environmental Health Action Plan for Europe, which aim at improving or preventing these 'hot spots'.

Human health situational risk or 'hot spots' could be represented by patterns of mortality. Mortality is related to a multitude of factors, ranging from the accessibility of health services to personal lifestyles prevailing in certain population groups. Some of the determinants may be related to environmental conditions. National data show average mortality rates without providing an insight into the diversification of the health status within the country. Furthermore, they preclude the detection of possible geographical patterns of disease distributions. The presentation of mortality data at subnational level in the form of colourful maps has great potential for the communication of information. It is the first step in a process that may lead to an understanding of the reasons for the varying levels of health. An interpretation of geographical patterns requires tedious analysis and studies to follow the description of the situation on the maps [5].

Other parts of the system focus on the geographical distribution of environmental hazards and of the exposure of the population, which provides the basis for health risk assessment. The priority areas are: air, water quality and accidents. The HEGIS contains an air pollution database with annual concentration for, at least, one pollutant for 315 settlements in 32 of the 50 countries of the WHO European region, which covers 43% of the total urban population. Combined with the data on urban population in Europe the information not only provides a basis for the estimation of the exposure of the population to air pollution and of the assessment of its health impact, it also identifies the towns with the highest average annual concentration of major air pollutants [6].

The application of HEGIS in the mapping of situational risks in the environment and health may attract the attention of public health authorities, and may direct international and national resources to the limited number of areas where the health status is far below the desired level and/or the environmental situation needs urgent intervention. A detailed evaluation of the situation focusing on these areas possibly followed by remedial actions of which not only the directly involved population can benefit, but which can also lessen the burden caused by the disease in other regions. The application applies two types of indicators: (i) health-related environment indicators (HREIs)—definable environmental conditions or trends which suggest potential harmful health effects and (ii) environment-related health indicators (ERHIs)—health outcomes which suggest an environmental cause or a contribution from environmental factors. The use of these two types allows HEGIS to be applied for the characterization and prediction of health risk and/or the identification of possible environmental factors responsible for adverse health effects. Key partners for the development of HEGIS include WHO, UN ECE, EEA, Eurostat, the National Ministries of Health and the National Ministries of Environment Protection.

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