

HEALTH INFORMATION SYSTEMS

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Summary

Medical information systems are now pervasive in most hospitals. However, *health information systems* (HIS) are essential to support decision making and planning to improve health policies that can promote global health development. For this purpose, HIS need to contain data on determinants of health, infrastructure of services, and cost/effectiveness of health interventions and health care procedures. The difficulty and cost of setting up systems for the collection of these data with the required comprehensiveness and reliability have produced systems that are called “data-led” because of the tendency to use data that are more easily available. However, what is required are “action-led” HIS, mainly in developing countries, to focus decision making and the data collection effort on those actions that can produce maximum gains in health with the resource base available. To achieve this goal, considerable changes in attitudes and concepts are required, as well as further research into the cognition of decision making in health policy and planning. New technologies, such as knowledge-based engineering, can be of particular value to maximize the wealth of knowledge available in any region. Action-led systems are likely to be highly dependent on mathematical and/or statistical modeling techniques to answer “What if?” questions in a given scenario. The relatively low cost of data storage and the increased connectivity of computer networks can allow the development of radically different systems without the need to waste time and resources to aggregate data at different levels of the decision making hierarchy. Computer technology is nowadays ingrained in the implementation

and operation of HIS, but it can be responsible only for the failure of an HIS, never for its success. In addition to improving the interdisciplinarity and technical background of professional teams in charge of developing and managing HIS, a major effort should be made to change attitudes about the value of information in health policy and planning by introducing the subject in the curriculum of schools of medicine and public health and by greater involvement of the community at large.

1. What is a Health Information System?

The quality of health care delivery or the effectiveness of health planning and policy making depend on the availability of accurate and timely information to support decision making. Broadly, a *health information system* (HIS) is any form of structured repository of data, information, or knowledge that can be used to support health care delivery or to promote health development. This definition is of relatively little value though because the term HIS has been widely used to include applications that are not immediately related to health development, such as computerized hospital billing systems. On the other hand, many information systems containing data on environmental or socioeconomic determinants of health that can be instrumental to support health policy making are not strictly regarded as HIS.

Despite the frequent association of HIS to computer implementations, the latter should be regarded simply as a convenient technology. The origins of HIS go back to the first records of causes of mortality in the eighteenth century, thus preceding computer technology by 200 years or more. Although most HIS are now running on computers, to allow an appreciation of the critical elements of HIS it is important to make a clear distinction between the conceptual structure of an HIS and its implementation technology. Many failures in the design and end results of HIS can be traced back to viewing HIS simply as “data on computers.”

The increasing availability of health data and information on the Internet has also contributed to blurring the concept of HIS. Most of the theory and experiences described in the literature apply to self-contained, dedicated systems that have relatively well established objectives or areas of application. Some information systems with these characteristics are available on the Internet, but in addition there are a large number of databases and an endless number of home pages offering a myriad of health information. The quality and reliability of the information available, though, have been frequently questioned. For health professionals and the general public in a position to criticize and select information, the resources available on the Internet can be valuable to support decision making and, as such, perform the role of a “classical” HIS.

More important than strict definitions of what constitutes an HIS is to concentrate on the contribution of information systems to health development, the challenges facing the implementation of such systems, and the future developments expected in this area. As with many other elements of health care delivery, HIS should be part of the health technology assessment framework. Data is an essential element of HIS and it is usually an expensive resource. Investments in HIS should look into its opportunity costs and the efficacy/effectiveness of its potential contribution to health development. This is the same as saying that whilst HIS are a tool to collect, select, synthesize, and disseminate

information about evidence-based medical care, its own development and utilization should also be evidence based.

A review of the literature indicates that 80%–85% of the systems described involve tertiary hospital applications and another 10%–15% mention applications in PHC and community health. Only 3%–5% of HIS have been applied to support health policy making or regional public health planning. The underdevelopment of HIS in this area is of great concern because of the need to improve the quality and rationality of decision making in health policy and planning and therefore for appropriate decision support. The following sections describe the basic components of HIS, with an emphasis on systems that can be used to promote population health development, including interregional and international comparative studies.

2. Health Information Systems and Health Development

Population health is determined by environmental, behavioral, genetic, demographic, social, and economic factors. Health policy aims to make the best use of a society’s resources to promote health by preventing or minimizing the occurrence of disease and by recovering health by deployment of curative services. Figure 1 indicates the interactions between HIS support to decision making, the determinants of health, and population dynamics. A number of *effector pathways* can be identified to channel actions that can target determinants of health (e.g. environmental control), or population health status (e.g. preventive or palliative care). Multiple data sets are required to reflect population parameters (demography, health, risk factors, access, satisfaction, etc.), cost/effectiveness of services/interventions, and resource allocation. The HIS should provide information that allows problem priority setting in a dynamic context, continually updated by incoming data.

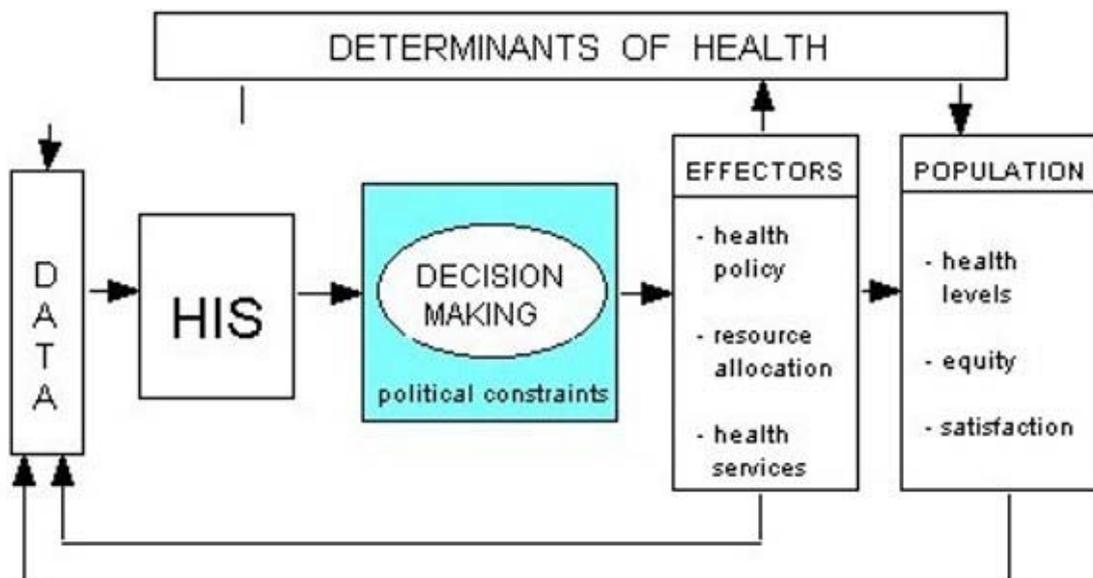


Figure 1. Main effector pathways for decision making supported by a health information system to affect determinants of health and population health levels, equity, and satisfaction with health services

Improvements in population health levels are particularly urgent in developing countries. Where resources for prevention and health care are scarce, HIS can be a tool for bringing about changes in resource allocation, priority setting, and management of services. Benefits should also be expected from greater involvement of the community in systems that not only collect data from but also provide feedback to and health education at primary health care (PHC) level. Despite these promising benefits, most developing countries are still struggling to implement HIS to support planning and decision making at the local and central levels. The limiting factors have been lack of political will, resistance to embrace a culture of informed decision making, absence of a critical mass of trained professionals, stifling bureaucracy, and incompetent management. This scenario cannot be generalized, however. In some countries in Africa the volatile political situation and the constant interference of armed conflict does not provide the necessary conditions of stability and long-term commitment required for data collection and training of personnel. On the other hand, most countries in Latin America have had experiences in setting up HIS at the central level of government, such as the Ministry of Health, Social Security, or units in charge of national planning and development. However, in most cases the HIS is not really a “system,” but separate databases of mortality data, incidence of infectious diseases, prevalence of tropical and chronic diseases, hospital admissions, or structure of health services. Long delays in the collection, collation, and distribution of these data are also frequent. As a result, much of the data available remain underused for purposes of management and planning.

A “bottom-up” approach has been suggested as the best way forward to promote change in the development and use of information systems in developing countries in contrast to the centralized or “top-down” model that has not been successful so far. This does not imply the complete exclusion of the central level that should retain a role in coordination and standardization. However, it is at the local level where benefits for health development can be more immediate by developing a culture of decision making and planning based on information and evidence rather than guesswork. Training of PHC managers and health workers and the involvement of the local community should be one of the main components of this strategy. By receiving timely feedback about the relative importance of health problems at the local level, it is assumed that the population would take a more active role in preventive actions and be more likely to show greater cooperation towards data collection and participation in health programs. Unfortunately, in most PHC clinics of the developing world this scenario is almost surreal due to chronic problems of staff shortage in relation to the demand for services, deficient installations and equipment, and lack of essential drugs and supplies. In this context, pilot projects could have a major impact to demonstrate the contribution of HIS for health development when incorporated as an essential tool for planning and management of services.

3. The Structure of Health Information Systems

The most common building blocks of any information system are depicted in Figure 2. This structure is somewhat independent of the technology used to implement the system. As an example, a manual system to monitor family planning practices in a primary health clinic will probably acquire the raw *data* from a questionnaire given to patients attending the clinic. In this case *coding* is usually built into the structure of the

questionnaire as many questions will have a discrete number of answers (e.g. contraceptive methods in use) or will be already in numerical format (e.g. number of children, date of birth, etc.). The *input* stage is also straightforward. The questionnaires will be *stored* in a file cabinet and copies might be appended to the patient records. *Processing* might involve a review of questionnaires and simple statistics of the main information of interest such as the number of children in the family, age distribution, percentage of couples on each contraceptive method, and so on. A typical *output* will be a summary report to be *distributed* to the staff in charge of the program.

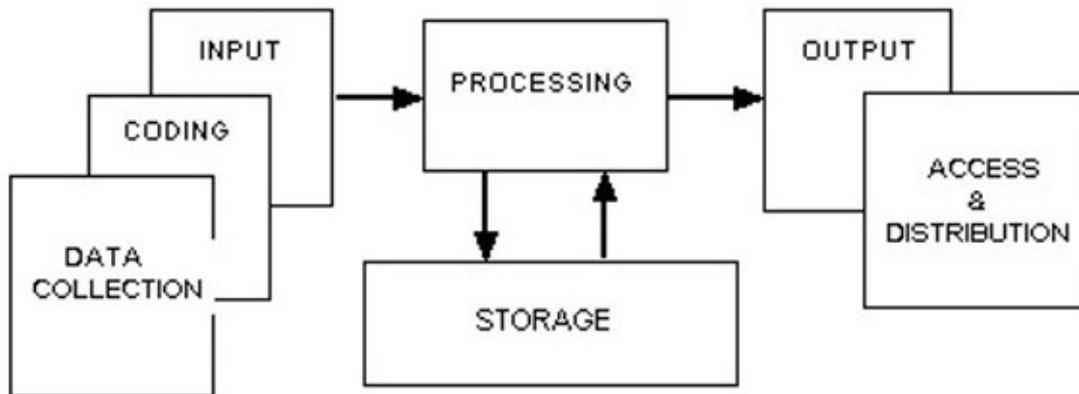


Figure 2. Main stages of a health information system

Despite the jargon commonly associated with computer technology (input, output, etc.), it is important to keep in mind that computers should be the servants and the HIS objectives the masters of the final product. In practice, the easy availability and low cost of microcomputers has made manual systems a thing of the past except in very poor or remote rural areas where computers cannot be afforded or adequately maintained.

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Biographical Sketch

Ronney B. Panerai was born in Porto Alegre, Brazil. After obtaining a B.Sc. in electrical and electronic engineering from the Federal University of Rio Grande do Sul in 1970 he moved to the biomedical engineering field having obtained an M.Sc. from the Federal University of Rio de Janeiro in 1973 and a Ph.D. from Imperial College, University of London, in 1978. From 1973 to 1991 he was with the faculty of the Biomedical Engineering Program, Federal University of Rio de Janeiro, Brazil. From January 1984 to June 1985 he was a visiting research associate professor with the Biomedical Engineering Department, University of Virginia, USA with a fellowship from the W.K. Kellogg Foundation. In 1986 he received the *Manuel Noriega Morales* award in Science and Technology from the Organization of American States, Washington, D.C. From 1985 to 1991 he was actively involved in the implementation of the discipline of health systems engineering in Brazil, including an active research program in health technology assessment and health information systems. In 1992 he joined the Division of Medical Physics, University of Leicester, U.K., where he is currently professor of physiological measurement. Professor Panerai has taught in many areas of biomedical engineering and medical physics, including biomedical instrumentation, biological control systems, biomedical signal processing, health systems engineering, and physiological measurement. His current research interests are in physiological systems modeling and biomedical signal processing.