Information Systems and Information Technology in Health

Challenges and Solutions for Latin America and the Caribbean

Health Services Information Systems Program
Division of Health Systems and Services Development
Pan American Health Organization
World Health Organization

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July 1998

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First edition
Number of printed books 1000

First reprint
Number of printed books 1000

ISBN 92 75 12246 6

Foreword

Although information systems have been long recognized as necessary for the planning, management and evaluation of health interventions, it was the emergence of affordable data processing and data communication that propelled the renewed interest in health informatics solutions to the operational and managerial problems of health systems and services. The more recent widespread deployment of computerized information applications in the health sector is the result of the many opportunities brought forth by the convergence of multiple digital technologies, the increased capacity and speed of modern computers, and the ubiquity of telecommunications. Much, however, remains to be done, as still persists a dissonance between the expressed desire for change, and the actual incorporation of information technology.

The appreciation of the essential role of information systems in health and healthcare, led the Pan American Health Organization to identify information as a priority area in the Strategic and Programmatic Orientations for the 1995-1998 period. Consonant with this orientation, in the second semester of 1995, a Program was established with the objective of promoting, coordinating, and supporting the development of health services information systems, information technology, and the management of the information function. The Health Services Information Systems Program, a technical unit of the Division of Health Systems and Services Development, was charged with the responsibility for the regional technical cooperation in the area of health services information systems.

The primary concern of the Program is to assist health professionals to effectively deal with the organizational and operational needs of healthcare services. The Program's action considers that all countries of the Region of the Americas have a common interest in improving the access and quality of healthcare, as a part of sustainable human development. The strategies adopted by the Program are in accordance to the tenets of the World Health Organization Health-for-All (HFA) Initiative, and the policy framework advocated by the Pan American Health Organization for supporting health sector reform efforts aimed at attaining greater equity, quality, efficiency, sustainability and social participation in health and healthcare delivery in the Region of the Americas.

Healthcare reform processes involve a variety of providers and stakeholders. This demands information and information systems capable of supporting a variety of perspectives and requirements. Planners and regulators must know why healthcare is needed, who will benefit from the services made available, what resources are to be utilized, and when and where services are to be provided. Managers, providers, and payers, in turn, need systems that support the day-to-day operation of services, programs and facilities, the functioning of healthcare practice around information as opposed around operational units, and the integration of organizational, population and individual data across different health subsystems. All require

decision making based in evidence and sensitive to economics—good management practices require informed resource allocation and the movement to promote evidence-based healthcare practice holds great promise for the improvement of quality, from public policy to individual patient care.

Health sector reform processes are different and diverse, and the information systems implementation environment is characterized by uncertainty, ambiguity, and rapid change. Managers, decisionmakers and systems professionals share a great responsibility in the specification, design, and development of information systems that are appropriate for that highly dynamic environment.

This publication attempts to answer some of the questions, concerns, and possible solutions in the use of advanced information systems in healthcare services. Besides an extensive review of the literature, the document reflects the experience of a large number of professionals and institutions, presented or discussed at international technical meetings convened by the Health Services Information Systems Program during the past sixteen months: the Expert Consultation Meeting on Telecommunications in Health and Healthcare, held in November 1996 in Washington, and the three Technical Meetings of the Informatics 2000 Initiative Health Task Force, organized in collaboration with the Inter American Development Bank, and held during the year of 1997 in Miami, Mexico City, and Washington DC.

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As the births of living creatures, at first, are ill-shapen
so are all innovations, which are the births of time.
Francis Bacon (1561-1626)

1. Introduction

Information is an essential element in decision making, and the provision and guidance of health care is a complex enterprise, highly dependent on information for a great variety of clinical and managerial decisions. To be useful, information systems must capture and process health and health-related data of broad diversity, scope, and level of detail.

1.1. Role of Information Systems in Health and Healthcare

When rightly designed and deployed, health information systems have the potential of producing valuable management-oriented administrative and clinical information for service and program operation and patient care. Such systems are critical to many areas: effective and efficient decisions for individual and collective healthcare activities, planning, operation, supervision and control, in the evaluation and monitoring of the health status of human groups, in the measurement of outcomes of clinical and managerial interventions, expansion of service coverage and better quality of care, enhancement and support of health promotion activities, augmented access to knowledge, and as a tool in the education of providers and consumers.

Information Systems in Organizations

Whereas all organizations have always had some form of information system to help them record, process, store, retrieve and present information about their operations, until recently, they have done so almost exclusively for accounting and fiscal purposes. The idea that information was much more than mere record keeping would have seemed strange to most people until a little after the middle of this century. It has been only in the last twenty five years that organizations have come to realize that information is a most valuable asset -- the quality of managerial decision making, upon which depends their success in a very competitive world market, is directly related to the quality of the information available to their managers.

Information systems, to be useful, must allow for a wide scope of health data. At all sector levels, the greatest need remains the establishment of continuous information systems that enable the recovery of patient-oriented, problem-oriented and procedure-oriented data to assist in the assessment of the impact of health services on the health status of individuals and populations. This realization has been gradually forcing organizations to perceive information systems in a different light, more as decision-support tools than as mere registry of past activities. Information systems are, accordingly, gradually moving out of the "back room" to which they have for so long been relegated and into the "front office" of executive suites.

Information, and the technology used to support its acquisition, processing, storage, retrieval, and dissemination, have, as a consequence, acquired strategic importance within organizations, ceasing to be elements that had to do only with operational and administrative support.

Appropriate information technology, when combined with a reliable health information infrastructure, facilitates and improves health data integration, analysis, and communication. Data-capture routines, processing tools, and methods to store, manipulate, access, and analyze

information must, therefore, be seen as an essential component of every health program and health service. In addition to addressing many of the compelling present-day health problems and providing tools for bettering health and human prosperity globally, the establishment of a health information technological infrastructure can assist the solution of the major challenges faced by the health sector: access, quality, finances, knowledge management, and better clinical and administrative practice. Although technology, *per se*, obviously does not replace the interaction between patients and providers, it can be effectively used to enhance such relationships.

The Role of Information in Health and Healthcare

Information is a most valuable asset. In the health sector, it is a key resource and an essential prerequisite for effective provision and management of healthcare. Improved access to information is recognized as an essential ingredient for health services and program planning, operation, control, and supervision and also as a tool for the evaluation of health activities and the results of clinical and managerial interventions.

Information is an essential element in decision making. A large number of experiences have clearly demonstrated the advances that can be achieved, in effectiveness and efficiency, by the utilization of an appropriately designed and properly established data collection and processing system with the objective of producing management-oriented administrative and clinically related information for operational support and decision making.

There is no consensus on the definition of information, but there is widespread agreement that it includes not only structured data but also free text, graphics, sounds (in particular the human voice), and still and motion pictures. Health information is any and all information related to health and it is therefore highly varied in nature. It encompasses, for instance, demographic data; information on social, cultural, economic, and environmental determinants of health; profiles on morbidity and disease-specific mortality; findings resulting from clinical practice or biomedical and epidemiological research; statistics on the activities of healthcare services, actions of health personnel, and coverage of health programs. But it also includes things such as patient records and files, with all that they contain: electrocardiograms, X-ray and CAT scan images, etc..

Health data rarely become health information. Massive amounts of data are produced and recorded in the healthcare sector, but the variety of potentially useful information that could be generated from those data is rarely fully utilized because, in most instances, there is no mechanism in place to process data into information and to make information available to the right people at the right time, in a format that is easily understood.

Data capture and its accuracy represent the most serious problems in the operation of information systems. When information systems do exist, major stumbling blocks confronted by systems operators relate to the quality of data sources and the timely data collection and recording.

The following example illustrates the predicament faced by anyone who wants to base his or her judgement on existing data. Auditing studies have shown that in the best of situations, the recording, classifying, and tabulation of causes of death, when compared with autopsy records or clinical charts, were found to have error rates of 60% or more. Indeed, because of lack of data to support it, it is said that there is no evidence that more than 10-20% of all forms of clinical intervention have any scientific basis for the claims made for their efficacy or safety.

Given the large quantity and the diversity of information that is required in the health sector, it is common practice to organize it in different health information systems. When information is structured in well-defined systems, it is collected, processed, stored, retrieved, and distributed more efficiently, and individuals and organizations use it more effectively.

An information system does not need to be computerized. However, most of today's more complex information systems can hardly be implemented without some form of computing and telecommunications support. The degree of deployment of information systems in the health sector is still quite modest and collected data are frequently rudimentary and of low quality when compared with data and information gathered in other sectors of the society, as is the case with the commercial and financial sectors, banking, agriculture, industry, tourism, insurance, and meteorology.

1.2. Evolution of Health Information Systems

Health information systems are not novelties; for decades a variety of manual data collection and reporting systems have been implemented and put into operation. More recently, some of those systems have undergone automation utilizing the modern resources of electronic data processing. The past twenty-five years, and particularly the past five, have witnessed significant strides in the use of computer-based information systems (Informatics) and computer-based networking and communications (Telematics) applications in the health sector of developed countries and, although to a lesser extent, in developing countries. Advances in computer-based and telecommunications technologies have created effective and cost-efficient opportunities for the deployment of systems that can contribute to the improvement of individual and community health conditions in local, national, and international settings. Still, the scope and contents of many information systems continue to be directed mostly to routine capture and processing of production and utilization statistics, maintenance of limited sets of health or health-related indicators, or the collation of morbidity and mortality data.

Los Angeles Free-Net: an experiment in interactive telecommunication between lay members of the Los Angeles community and healthcare experts

The Los Angeles Free-Net, an interactive community information resource, was established in part to help community members become more effective consumers of healthcare services. By providing timely, expert answers to anonymously asked medical questions at no charge, we hope to decrease unnecessary physician-patient encounters, encourage effective preventive-health measures, and improve the overall results of health care in our community.

Although it is too early to assess healthcare benefits from this system, the following observations may help guide the development of similar systems around the nation:

A small annual registration fee generates both moral and financial public support.

Demographic information from registered users can help direct attempts at enfranchising all members of the community.

Toll-free access, free public-instruction sessions, moderated forums, extensive volunteer help, and encryption security are encouraged, while Internet censorship is difficult and counterproductive.

Access to Internet resources is important, but the strength of a community system lies primarily in the sharing of expertise and resources among members of the community.

A critical mass of available physicians to answer questions must be matched with a critical level of question input for this type of interactive medical information resource to function in a time-sensitive fashion.

(*excerpted from* Bluming, A. and Mittelman, P.S. (1996). Bull Med Libr Assoc 84(2): 217-222)

The more recent definition of the term "Health Informatics", as proposed and adopted by the World Health Organization and the Pan American Health Organization and used in most scientific and international fora, contemplates and includes the "telematics" component. "Health Informatics (HI) is an umbrella term, used to encompass the rapidly evolving discipline of using computing, networking, and communications -- methodology and technology -- to support health-related fields, such as medicine, nursing, pharmacy, and dentistry." This definition covers a very large domain which includes: clinical and administrative messaging, operation and management of

health services, patient information, health education and promotion, epidemiological surveillance and health status monitoring, clinical decision support, reference retrieval, image and signal analysis, modeling, telehealth, and telemedicine.

Health Informatics comprises practices, products, and services and shares a number of characteristics with a growing number of industries categorized as knowledge-based industries. The principal asset of Health Informatics is knowledge -- both as input and output -- which is the key source of innovation, technological development, and long-term growth and job creation. Health Informatics is technology intensive, a common characteristic of knowledge-based industries, and involves computers, telecommunications, networks, multimedia, robotics, artificial intelligence, and virtual reality. Applications of Health Informatics share common elements: components and the context of their implementation environment, computer-based technologies and telecommunications, human and organizational resources, and business and market challenges.

1.3. The Technological Basis of a National Information Infrastructure

Just as information is central to providing improved care at a lower cost, an advanced national information infrastructure is key to providing easy access to this widely dispersed information. The trend, as observed at the international level, indicates that there is a growing interest and benefit in the deployment of a broad spectrum of applications bring automation to providers and clients (Fig.1).

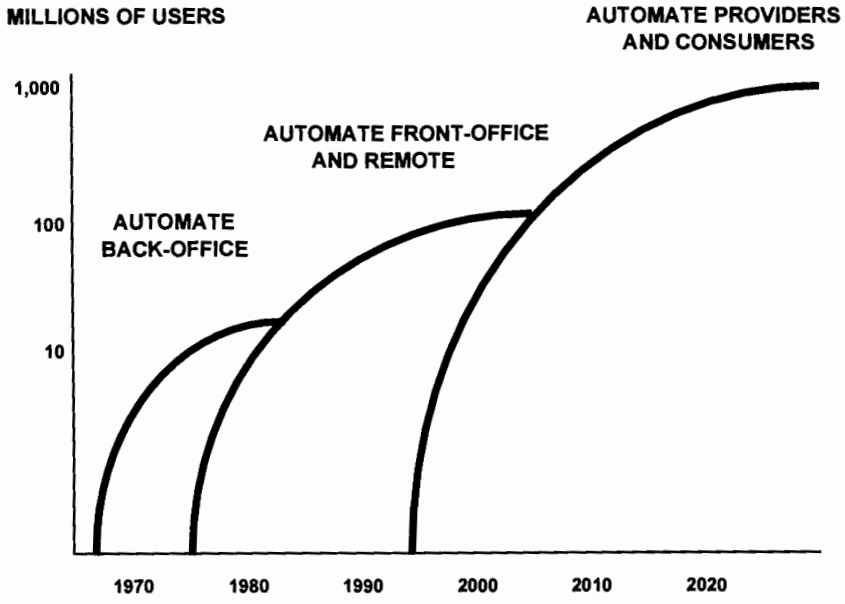

Fig. 1 - Information Technology International Market Growth

Significant transformations are rapidly occurring throughout the world as a result of the merging of multiple technologies related to computers and telecommunications and their application in the productive and service sectors of society. Part of these transformations, based upon changes in the way we process, store, and transfer information, is the Global Information Infrastructure (GII)). We have now available an expanding range of technologies including scanners, compact disks, cable, wire, fiberoptic, wireless devices, and satellite dishes with which to transmit, store, process, and display voice, text, data, and images.

Strategic and Tactical Issues in Information Systems (IS) and Information Technology (IT)

1. Strategic issues in IS involve:

- Creation of professional and general staff awareness regarding the role, advantages, and limitations of information systems and related technology.
- Definition and establishment of policies and strategies regarding the development, introduction, and operation of information systems, including roles and responsibilities involved.
- Identification of information systems concerns that must be considered in the action plan of programs, projects, and organizational units.
- Establishment, support, and continuous operation of an organization-wide advisory committee on information systems.

2. Strategic issues in IT involve:

- Definition of characteristics of the technological resources that are most appropriate to satisfy the demands of the organization, the existing and future IT organizational environment, and the alternatives for application development.
- Definition of the balance between centralized and decentralized technical resources for the delivery of technical services and for systems development, implementation, and operation.
- Definition of the guidelines for the management of systems, including the budget, its distribution, and the control of the information function.

3. Tactical issues in IS involve:

- Collaborative definition by users (unit, program, project managers, and high-level managers) of required and prioritized applications.
- Definition of alternatives for systems implementation, appropriate routines and procedures, and the identification of staff responsible for systems operation and maintenance.

4. Tactical issues in IT involve:

- Establishment of technical guidelines for the acquisition and deployment of data processing and data communication hardware and software.
- Establishment of technical guidelines for individual application development including in-house development, contract development, transfer or off-the-shelf acquisition.
- Definition at application level of needs regarding user training, operational routines, and data-related procedures and security.

The complex web of communications networks provides the ability to put, at low cost, massive amounts of information at users' fingertips in virtually any place in the world. In time, this global infrastructure is expected to evolve into a ubiquitous communications infrastructure that will be many times more powerful than today's public and private networks. Many sectors of the world economy have the capacity to influence -- and be influenced by -- this emerging information infrastructure, including manufacturing, education, electronic commerce, libraries, government services, and health systems.

The Global Information Infrastructure is already present in eighty-two countries and, in the form of the Internet alone, it is used by more than thirty-six million people internationally and is expanding at an exponential rate. The health component of the GII creates opportunities and can dramatically improve the practice of knowledge-enhanced telehealth and the constructive reengineering of national and international health systems; the creation of local, national, and global markets for the exchange of health products and services; decentralization of healthcare; improvement of health status; and the protection of the biodiversity of ecosystems.

To developing countries or communities, the GII offers the potential for a quantum leap in health, quality of life, and functional life capacity. These benefits, however, will be realized and sustained only if the technology and applications are designed and deployed to simultaneously address the immediate operational needs of the health sector and the impending macro challenges we must now face on a global basis.

One prime area where global linkage has the greatest potential is in distance learning. Many universities already provide vast arrays of subject matter for distribution anywhere. Continuing medical education transcends geographic or geopolitical isolation. Courseware is now being developed in hundreds of subject areas, in several languages, and directly applicable to international medicine and global education. It permits access to basic, intermediate, and advanced course work by physicians, technicians, nurses, and allied health workers who may substantially enhance their skills by utilizing that teaching modality.

Internet-based and other interactive communication technologies present opportunities to improve both personal and public health. A range of interactive media applications are now being used to assess and reduce health risks, promote healthy behaviors, and provide information and decision support about health and medical choices. These technologies hold considerable promise in improving community and individual health status and in reducing healthcare costs.

An example of the extensive coordination required for optimal utilization of computer and telecommunications technology is the U.S. High-Performance Computing and Communications (HPCC) program. HPCC is a multi-agency federal effort to advance the state of computing and communications and to provide the technological platform on which the National Information Infrastructure (NII) can be built. The HPCC program, although still too expensive to serve as a model to be emulated by developing countries, supports the development of high-speed computers, high-speed telecommunications, related software and algorithms, information infrastructure technology and applications, and education and training.

The vision of the NII is to extend access to high-performance computing and communications to virtually every U.S. citizen so that the technology can be used to improve the civil infrastructure, lifelong learning, energy management, healthcare, etc. Development of the NII requires the resolution of complex economic and social issues. Health-related applications supported under the HPCC program and NII initiatives include connection of healthcare institutions to the Internet; enhanced access to gene sequence data; the "Visible Human" Project; and test-bed projects in telemedicine, electronic patient records, shared informatics tool development, and image systems.

Sharing and Communicating Health Care Information

Sharing and communicating information is a fundamental task in modern medicine. The healthcare system of the Western world is based on teamwork of professionals who participate in the care of patients. Exchange of information (not just data) requires the communicating parties to agree on a communication channel, an exchange protocol, and a common language. The language includes an alphabet, words, phrases, and symbols that express and assign meaning, understood by all. The most common forms of communication are the spoken word and the paper-based patient record.

Computers and communication systems improve the sharing of health care information by overcoming the limitations imposed by the dimensions of time and location. However, natural language is still too complex and too ambiguous for current computing devices to handle the complex interactions between health care professional and patients. A simpler 'language' is needed that uses domain specific vocabularies (and/or codes), well-defined exchange protocols for data, information, knowledge, and, in the future, perhaps even wisdom. This simpler 'language' is expected to handle most of the routine information exchange but not eliminate natural language. It is essential that health care information systems preserve and incorporate natural language expressions and integrate them with structured vocabularies. Today, agreeing on standard data exchange protocols and domain specific vocabularies and codes is our greatest challenge. However, standards alone are not sufficient. Acceptance of the standards by the healthcare professionals is the central issue in their widespread use.

(*excerpted from* Orthner, et al (1994) Int J Biomed Comput 34(1-4): 303-318)

Recent innovations in microelectronics and advances in cryptography are driving the appearance of a new generation of smart cards with wider applications. This will result in important practical and affordable applications in the coming years. Essentially, these breakthroughs include built-in microprocessors capable of generating cryptographic transactions (e.g., electronic signatures and digital credentials), development of a single electronic card offering multi-access to services such as transport, telecommunications, health, financial, entertainment (Universal Access Services), and the incorporation of personal identification technologies such as voice, eye, or skin pattern recognition. Moreover, tamper-proof electronic equipment can make smart cards a very attractive technology for high-security applications, such as those in the healthcare field. New trends in smart card technology offer excellent privacy and confidentiality safeguards.

A rapidly growing area within the field of clinical medicine is the increasing utilization of centralized telephone triage and health orientation systems (Consumer Call Centers) to assist in the after-hours coverage, to provide linkage to the primary care physician, and to provide emergency medical help. The service can be enhanced by the concomitant use of automated medical records system (Electronic Health Record or Computer-based Patient Medical Record). Interactive health communication technologies involve the connection of an individual with electronic information and communication technology, most commonly a computer, to access information or to receive

guidance on a health-related issue. Applications include those that focus on promoting individual and community health, improving self-care, educating patients, and promoting healthy behaviors through provision and sharing of information and structured decision-making processes. In the U.S. in 1997, more than thirty-one million persons reported using the Internet or on-line services on a regular basis, and an increasing number of them use decision-support applications.

Telematic Systems for Health in Europe: A look Toward the Future

European national health services of the future will rely greatly on telematic systems to lower the costs and raise the quality of healthcare, says Jesús Villasante, from the European Commission DG XIII, who describes the objectives and difficulties of telematic health systems.

Economic challenge

The general availability of advanced telematic systems and services will play a key role in the competitiveness of Western economies and in the efficiency of public services in the next decade. The development of such systems and services will provide important business opportunities for industry and service providers. New and innovative SMEs (small and medium enterprises) will play a central role in offering specific solutions to user communities based on emerging generic telecommunication services. It is estimated that by the end of this decade a third of the telecommunications market will comprise services, with the other two-thirds shared equally by terminal equipment and by switching and transmission systems. A number of factors will make healthcare a strategic sector for the use of telematic systems. First, the scope of the health sector and its position as the largest public service market in the Community. Second, the demands that exist in terms of the need to store and manage information. Third, the growing number of opportunities to improve efficiency and quality of care by using advanced technologies.

Community support

Recognizing this, the European Community has been investing in R&D for telematics systems in healthcare since 1988. This was initiated with the AIM (Advanced Informatics in Medicine) Exploratory Action which, under the third Research and Development Framework Program, was incorporated in the program "Telematic Systems in Areas of
General Interest (1990-1994)". During this time the European Community invested some 128 million ecus. This is only part of the total investment because of the shared funding nature of these programs, which means that project partners generally contribute an equal amount of resources and costs. Industry, national health services, and research institutes represent the major source of investment in this sector.

So far there has been clear progress, and the programs have made a major contribution to establishing a common approach, a common perception of objectives, and a common platform for the development of telematic systems and services for healthcare in Europe. New concepts and advanced applications have been realized and there has been a significant amount of new interest and activity generated in the sector, which demonstrates well the viability and importance of multidisciplinary collaboration at European level. There has also been an important mobilization of actors in this market, who are now working and collaborating at a European level. This is a fundamental aspect given that the development and implementation of future systems will depend largely on collaboration between the various sectors of the healthcare market, industry, telecommunications operators and research organizations.

Healthcare: a strategic sector

Health is by its very nature an intensive user of information. The application of advanced technologies to the collection, storage, retrieval and communication of this information will be one of the critical success factors for the health services of the member states. Those responsible for the provision of healthcare services understand that it is possible to improve the quality and the cost-benefit equation by the effective introduction of telematics systems and services which will transform the traditional structure of health service provision and availability.

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Equally, the healthcare sector represents an excellent market for industry in general and SMEs in particular. Healthcare is the largest and most important public services sector in terms of human and economic resources and we need to ensure that European industry and the telecommunication service providers can compete effectively by supporting a coherent common platform which strengthens and brings together the existing technological base and the forces behind it. The free circulation of people and services in Europe, and the right to receive an adequate service in health independent of the location of the patient, justifies the need for telematics services and systems for health care as an element of social cohesion.

Objectives of healthcare telematics

- To facilitate access to quality care and to allow knowledge and advanced medical technology to reach all patients.
- To enable the assembly of a complete record of patient information, independent of the patient's location and respecting standards of confidentiality of information.
- To facilitate collaboration between clinical professionals and health institutions to optimize use of resources.
- To allow clinical professionals remote access to information and to available medical knowledge.
- To make relevant information available for use in the management and optimization of healthcare services.
- To make health information available to all citizens to facilitate home and self care in line with the trend away from treatment in institutions towards treatment in the community and in the family unit.
- To use statistical or other information to highlight possible risks to the health of the community in terms of drugs, medical equipment, or food hygiene, and to derive preventative measures.
- To ensure that the accounting and reimbursement of costs can be organized in an effective and accurate way, and which represents the best-value compromise between available resources and needs.

The future is integrated

Traditionally, the application of informatics in healthcare has been characterized by specific, local and often isolated solutions. Present trends in healthcare telematics include more global and systematic approaches aimed at improving quality and efficiency in the healthcare sector overall. The availability of such an environment will allow citizens to relate in different and more efficient ways with health service providers. Using technology, often developed in other sectors, will create a more effective paradigm of services where real needs, clinical knowledge and ethics, and economic constraints can be balanced to avoid unnecessary time, pain and cost.

(*excerpted from* Health Informatics Europe, June 1993)

Searching for health information is one of the most common reasons for public use of the World Wide Web, with thirty-seven percent of adult Internet users reporting regularly accessing electronic health information. Individuals are increasingly turning to the Web and other electronic sources for health information, and they are becoming more knowledgeable consumers of healthcare. The use of computers to facilitate the sharing of ideas and experiences with others in similar health-related situations not only results in better-informed consumers but also may provide social benefits that have a great potential impact in health promotion and illness prevention.

Interactive community information resources have been established to help community members become more effective consumers of healthcare services and, by providing timely expert answers to anonymously asked medical questions at no charge, that type of service has proved to decrease unnecessary physician-patient encounters, encourage effective preventive-health measures, and improve the overall results of healthcare in the community. Access to Internet resources is important, but the strength of a community system lies primarily in the sharing of expertise and resources among members of the community. Telecommunication networks that link medical information with the community can support home caregivers while providing skills training and crisis intervention to prevent unnecessary hospitalization. Health-oriented telecommunications redirect the traditional focus from intervention to prevention -- consumers become empowered with knowledge allowing them to participate in their healthcare and lifestyle decisions.

Building Inter-Organizational Information Systems

Information systems have traditionally been developed for one organization. The objectives of the system have been stated by the organization, and the costs and incomes generated by the system have been addressable to that particular organization. New inter-organizational requirements for data and information processing and communication will cause many deviations from this simple situation.

Inter-organizational information systems (IOSs) are systems by which independent organizational units communicate by the means of data transfer from one computer memory to another. Inter-organizational information systems clearly need different management, systems development, and use practices from ordinary intra-organizational systems. The main points of difference seem to be that IOSs:

- Cannot always be legitimated in the short run (the time period present in most conventional cost/benefit analyses) by the operational or strategic benefits they bring -- these take time to occur;
- Must be based on sufficient current systems, especially databases, telecommunication equipment, and standards;
- Put stress on cooperative and communication skills of systems professionals;
- Often need priority arrangements in initiation phases; and
- Require heavy dedication in both the quality and intensity of use.

2. Sector Reform Processes Demand New Orientation for Information Systems

The health sector, in nearly all countries, is facing two demands that appear, on first examination, to be contradictory: firstly, to provide expanded and equitable access to quality healthcare services and, secondly, to reduce or at least control the rising costs of healthcare services. Increasing costs compete for valuable resources from the economy and curtail the ability to compete successfully in world markets. At the same time, there are growing demands on the healthcare system for additional and higher-quality services. Many still do not have access to appropriate care or cannot afford it, and with aging populations the need for medical care increases. Traditional revenue streams that have supported indigent care, public health interventions, medical research, and education are insufficient or being reduced, forcing healthcare organizations to seek new methods to support these vital activities. New partnerships among healthcare providers and payers require more and better clinical practice guidelines and clinical outcome information.

Most health sector reform initiatives have been grounded in the universalization of a high cost-benefit basic package of health services, a set of standardized public health interventions, cost containment and recovery, administrative decentralization and operation of healthcare services, and the recognition of the role of the private subsector and intersectorality of health interventions.

There will be major changes in the manner healthcare is provided and a growing separation between organizations that provide, regulate, and finance health interventions. New roles are expected from users and providers and the involvement of new professional categories and local government. Health organizations are already moving away from the reactive delivery of care to a more proactive management approach of the health status of individuals and population groups, and the mission of organizations will be constructed considering the perspective of the client and other social actors involved in the health intervention processes. In market economies, competition, the merger of provider organizations, aggressive contracting by payers, and increasing involvement of employer and government purchasers have characterized the changing process of health management.

The new health models now being discussed, designed, and implemented are oriented towards primary care; are centered on people; are focused on quality, sound financing, and accountability; and stress explicitly defined targets for improved health status. New roles are expected for users and providers and the involvement of new professional categories and local government. In this new environment, information systems are essential and must be designed and implemented in an appropriate manner to be able to support the diversity of perspectives of regulators, managers, payers, providers, and clients.

The restructuring to improve quality and service while reducing costs will not succeed without access to more and better information. The reform processes and their operation must include the ability of payers, providers, and clients to select services offering quality care at the minimum possible cost. To achieve this goal, an appropriate definition of quality must be articulated and adopted; data to be captured and their definitions must be agreed, and measures and

mechanisms must be in place to analyze those data. Communication and publication of results are necessary in making informed choices.

The Reason for Health Sector Reform

Health sector reform is a process aimed at introducing substantive changes into the different agencies of the health sector, their relationships, and the roles they perform, with a view to increasing equity in benefits, efficiency in management, and effectiveness in satisfying the health needs of the population.

This process is dynamic, complex, and deliberate; it takes place within a given time frame and is based on conditions that make it necessary and workable. The health sector, despite the fact that it is key to greater well-being for the population, the formation of human capital, and the existence of positive experiences in applying the primary health care strategy, has not kept pace with the momentum of change that the Region has experienced in recent years in other areas of economic, political, and social life.

Whereas the Region struggles to transform itself from within so as to be more competitive in the new world order, the health sector needs to cast off old moorings that prevent it from modernizing in organizational, technological, political, and administrative areas.

Public health services constitute an important ingredient of standards of living, and their impact will grow as the sector in its entirety operates better. If it is to fulfill its role, the health sector must be viewed as an integral and contributory sector of the economy and productivity must be a principal concern. Thus, it is imperative for the sector to improve efficiency in allocating resources in order to focus more of them on effective interventions to protect the health of the population.

In light of these problems, health reform processes in the Region have to take into account a series of guiding principles, consistent with reform of the State, so that the State is supported in its roles of establishing overall health priorities, assuring care for essential needs of all citizens, and reallocating scarce resources to address the inequalities affecting the most disadvantaged sectors of the population. These roles assume that health of its citizens remains included among the fundamental responsibilities of the State.

What is health sector reform in the Region responding to? What are the events that justify the need for this change? Answers could be found in the following:

- Significant opportunity exists to improve health status: in spite of progress over the last few decades, there are still a considerable number of preventable diseases and premature deaths, in absolute and relative terms; Latin America and the Caribbean have an excess mortality of around 50%.
- Changing demographics (particularly age structures) and lifestyles (mainly due to epidemiological profiles, urbanization and growing industrialization) highlight the need to reorient care models.
- Inequitable access to basic health services: vast regional areas and social group shave been left without equitable access to the basic health care that all citizens need.
- Lack of coordination between national institutions, subsectors, and intersectorally.
- Inefficient allocation of scarce resources.
- In some countries the health sector is underfinanced; this has led to quantitativeand qualitative deficiencies in the delivery of health services and to growing gaps in basic care.

(*excerpted from* Document on the Special Meeting on Health Sector Reform, September 1995)

To achieve the goals of the reform, factual evidence must be gathered, processed, and analyzed, and the reshaping of healthcare delivery and the strengthening of management requires a well-developed informational infrastructure and validated knowledge bases. In this scenario, improvement of information handling is a key element for the management and operation of

decentralized and participative health services, in the improvement of equality of access to services, in the enhancement of the quality of individual patient care, and in the monitoring and control of public health actions.

The Objectives of Health Sector Reform

What are the fundamental objectives for which health sector reform strives? What are the underlying premises of the implementation strategies for reform? In essence:

- To improve the health and living conditions of all the inhabitants of the Americas.
- To become part of the social reform in the Region, one of the pillars of development, along with justice, well-being, and equity.
- To reduce health status inequalities, improve access to good quality health services, and foster shared responsibility between institutions, individuals, and communities.
- To modernize and decentralize the organization and operation of public institutions providing health services;
- To balance the public and private health subsectors in order to achieve complementarity in their efforts.
- To ensure that reasonable financial resources are available to the sector at a sustainable level to allow its objectives to be met.

Comprehensive reform cannot be expected to meet all its goals in a short period. However, it is a component of the social modernization that our countries require, and the problems which must be faced can be addressed through a combination of political will and technical and administrative resources.

The situation requires the processes of health sector reform to be implemented through a set of strategies that are not only politically, technically, and administratively viable, but economically sustainable as well. They must be mutually coherent and, to the degree possible, capitalize on the institutional achievements that have been made in each of our countries.

(*excerpted from* Document on the Special Meeting on Health Sector Reform, September 1995)

Healthcare providers such as physicians, nurses, and other practitioners, along with healthcare delivery organizations such as hospitals and managed care systems, need access to more complete and better-integrated patient data. Along with payers, providers want more consistent data regarding the outcome of diagnoses and treatments. Payers and regulators want more details regarding the performance of different health plans, and citizens need access to information to assist them in staying healthier longer and self-managing their health conditions.

Present trends in the organization of healthcare require that emerging information systems must be realigned to the following demands:

- Ability to capture and deliver data and information at the point of service;
- Change in focus from an illness-based model of care delivery to a wellness model;

- Intensive information manipulation;
- Concurrent and multicentric approach to information utilization; and
- Shift from retrospective to concurrent decision making.

Decentralization of Information and Information Systems

The focus of the new health information systems must be on the local level. It is there that basic health care is delivered to the population and where most of the information required for action at the regional and national level is collected.

In addition, the strategy adopted by the Member States of the World Health emphasizes the importance of the primary health care level. The development of local or district health systems with the objective of serving well-defined populations within certain administrative and geographical boundaries, and the establishment of various degrees of autonomy, within a concept of a hierarchical decentralization, has been proposed as an answer to the managerial and service delivery challenges faced by the health care sector in most countries. This is the level of first contact between the user of health services and the health system. Even patients who may need more specialized care (through referral or telemedicine) will normally enter the health system through the local level. Local health systems may vary depending upon size, political constraints, traditional organization of health services and other indigenous factors and characteristics. Each country is expected to find its own solution for the proposed decentralization strategy.

The local systems are expected to have greater flexibility and better response to changing requirements of specific population groups than previous models. Realization of decentralized systems presupposes the reorganization and reorientation of the sector's overall structures and their network of facilities. The strategy has fundamental implications for the definition of characteristics, resources and functionality of the information systems which must be conceived, developed and implemented in such a way as to be consistent with its operational environment. Networking of health facilities and providers constitute a central element of the new healthcare models.

Although information collection takes place at the local level even in the case of the conventional health information system, the focus of the conventional health system is not on the information needs of managers and professionals at the local level, and so these needs are rarely taken into consideration. To place the focus on the local level, however, does not imply that the information needs of the higher levels will not be taken into consideration. The regional and national levels of the health system will receive the information they need, but they do not need detailed or itemized information on every individual transaction that takes place in the periphery. What they need is aggregated information. The detailed and itemized information, when needed, should be collected, processed, made available and stored locally. It is also at the local level that information should be aggregated in the form required by the national and regional levels.

A Real Case Story to Consider

Oxford's Information Technology Disaster

On October 28, 1997 the fateful Wall Street "crash" of the year, one of the biggest losers was Oxford Health Plans. The largest health plan in the state of New York, and one of the fastest-growing HMOs in the country, Oxford saw its stock fall by two thirds, from $68 to $25 per share: a loss of $3 billion on 49 million shares. That same day, Oxford announced losses of $78 million due to a host of billing problems. Oxford, based in Norwalk, Connecticut, blamed its great fall on a flawed computer system that failed on both ends -- receiving and collecting. The company has announced measures to get the company back on track. In the meantime, the fear for every healthcare manager is that problems like Oxford's could surface in any health system that isn't careful in managing its information technology.

"These organizations are absolutely, totally information intensive and information dependent companies," says Thomas Johnson, a managed care consultant with Sheldon I. Dorenfest Associates in Chicago. If the information is inaccurate, a managed care company loses its primary function: managing costs. Johnson said his perception is that Oxford is run by a "brilliant and visionary" executive staff, but the marketing and sales force outstripped what the company's technology systems could handle. "You had an information system director sitting there every day who had something new presented to him," Johnson said. But the system couldn't keep up with Oxford managers' demands. "I think they fully understand that at this stage, but it's not an unusual problem in the industry," Johnson says. The problem at the root of such disaster may be the frantic pace of competition in managed care. Managed care firms are being forced to merge and/or introduce innovations to attract and retain customers.

"The real question is whether or not information technology was fully to blame [at Oxford] or whether there are other factors illustrative with all the consolidation and growth in healthcare," says Ray Falci, healthcare technology analyst with Piper Jaffray in Minneapolis. Oxford's information technology problems began in 1992 when executives asked for more powerful and flexible technology that could respond to the company's explosive growth. Oxford doubled in size to 1.9 million members in just 18 months.

The information systems division chose to build a new system internally, atop databases from Oracle Corp., and to move away from the older, patchwork-built system from Computer Sciences Corp. Marc Hebert, a vice president from the Oracle Alliance Program, didn't work on the Oxford project, but he called the Oxford situation "a classic systems management problem" of transferring a large legacy database to a new database system.

"There's no magic to it," said Hebert, who previously was employed with Arthur Andersen on similar conversion projects. "It involves thinking through the detail of what does that data look like." In Oxford's case, the devil was in the details -- big and small. The new system took far longer to build than anticipated. Contributing to the problem was an unusually high turnover among programmers. Over five years, Oxford employed 100 outside systems contractors. It was obvious, according to Hebert, that the new system was never properly tested to see if it worked.

The result was catastrophic. Providers were so late in receiving payments from Oxford, the New York attorney general's office intervened. Oxford responded by advancing estimated payments to providers for unresolved claims. Oxford's error was further compounded by underestimating rising medical expenses, especially for Medicare patients. Worse still, customers weren't billed on time -- and sometimes not at all. When Oxford tried to bill belatedly for premiums, customers balked and some companies dropped altogether. Rather than try to collect, Oxford chose to write off its losses. A prepared statement claims that it has brought in auditors from KPMG/Peat Marwick to help straighten out the mess and it is installing new hardware to speed up claims processing. It is calling in a variety of experts, including ThinkMed Software, Milwaukee.

(*excerpted from* Healthcare Informatics / News & Trends, vol 15(1), January 1998)

3. Functionalities of Information Systems in the Context of Healthcare Reform

Deployment and utilization of information systems and computer-based and telecommunication technologies require adaptability to the variety and changing requirements of the sector. This is particularly important at a time in which new health models are being discussed, designed, and implemented.

Information, Informatics, and Organizational Change

Organizations that have clearly understood the strategic importance of information and informatics have even gone as far as changing, in some cases drastically, their organizational structure, in order to make room for the new role of information systems and informatics. The old data processing units and even the more recent information centers have been totally redefined, being replaced by smaller and more flexible units, distributed throughout the organization, but operating, under the control of a Chief Information Officer, in an integrated manner, thanks to the existence of effective computer and telecommunications networks and of powerful software.

Alongside these changes, effective users of information systems and informatics have seen their role and importance increase vis-á-vis those of computer and telecommunications specialists. The decision maker, equipped with a full complement of analytic and managerial skills, is the central and most important component of any information system, manual or automated. The benefits of computers or of electronic data processing are not to be denied, but it must be kept in mind that these only record, store, manipulate, and retrieve data; they are no substitute for clear and logical thought.

The area of informatics, until fifteen years ago under tight and exclusive control of highly technical specialists, has been opened up and become accessible to competent and interested professionals of other areas. At the same time, the evolution of software has placed in the hands of these non-specialists powerful tools for the development of applications. Important movements resulting in profound organizational changes, such as those proposing downsizing, reengineering, and process reengineering, would be inconceivable without the new view of the role of information in organizations and the new resources made available by informatics.

The health sector will not escape being profoundly affected by these change and the information systems that will bring the health sector in conformity with the new paradigm just described will basically have the following characteristics:

- Sector reform will require a new approaches to systems specifications
- Increased integration of internal and external data and information and concurrent users
- Focus on the local operational level and point of service support
- Added requirements of preventive care and health promotion
- Emphasis on managerial and professional decision-making and accountability
- Flexible and integrative design that integrates technologically different platforms
- Tools for analysis, interpretation, and dissemination of data and information
- Increased user responsibilities and involvement in systems design and operation

In the context of health reform, information systems must address requirements related to the support of healthcare interventions to individuals and communities, monitoring of health-related indicators, and the monitoring of the health reform processes:

- *Support of healthcare delivery* - management of resources, contracts, and multiple stakeholders; management of facilities and equipment; reimbursement for services provided; cost recovery; logistics and the support of operations; access to individual patient information in a distributed environment; access, rationalization, and sharing of resources through telecommunications technology; access to knowledge bases to support evidence-based practice; and the promotion of healthy behaviors and self-help.

- *Monitoring of health status of populations* - epidemiological information; environmental health; morbidity and mortality.

- *Monitoring of reform processes and their impacts and healthcare outcomes* - dynamics of the reform processes; contents of reform initiatives; equity of access to services; effectiveness, efficiency and quality of interventions; financial sustainability; and community participation.

Changing implementation environments, variety of professional and institutional objectives, and the multiplicity of settings, in which the sector reform is being conducted, represent a great challenge to information systems developers. In this new environment, information systems must be designed and implemented in an appropriate manner to be capable of supporting the diversity of perspectives of regulators, managers, payers, providers, and clients.

Installing Systems Successfully in Managed Care Organizations

The installation of a new administrative system is a tremendous undertaking for any organization, affecting every area of the operation. Often, because of time and budget constraints as well as the perception that change is not immediately necessary, many organizations wait until there is no option but to change systems -- then make the changes within short time frames. For a large, multisite organization, the issues are the same but the complexity increases tremendously.

A new system can help provide critical capabilities for a organization's success. The process of installing the system in order to gain those advantages is often difficult and requires tremendous discipline. Daily demands on personnel, changes in the market and conflicts about running the business are all potential barriers to the process. While there is no "magic bullet" to make the transition easy, attention to a few basic concepts, will allow the organization the best chance of success.

- Right people, right training
- Managed care is highly integrated; configuring or changing one module may affect the system in several other areas
- Unified leadership
- Business goals, not systems goals
- Strong, detailed project plan
- The organization needed to maintain an integrated application environment is often ignored in light of more pressing installation decisions

(*excerpted from* Healthcare Informatics, February 1997)

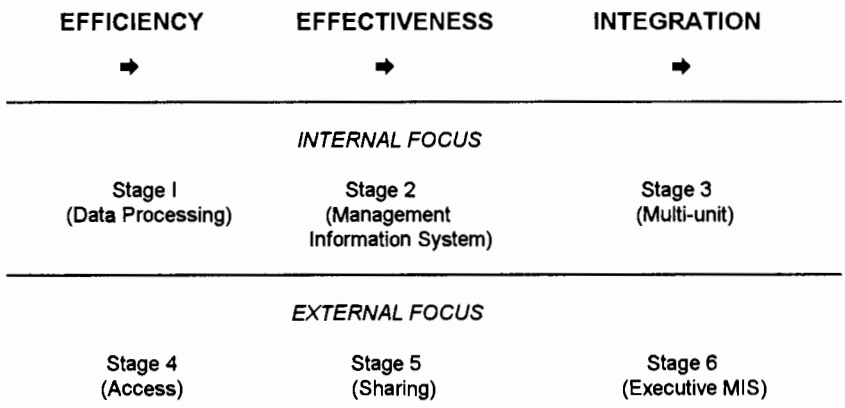
With the implementation of health reform initiatives in the Region, information systems must be oriented towards primary care, centered on people, focused on quality, sound financing, and accountability, and must stress explicitly defined targets for improved health status.

Planning of information systems development must take into primary consideration the hierarchies of information as they relate to the existing organizational structures and possible decisions to be made by managers and direct healthcare professionals that are expected to be supported by the system. In this context, it is customary to differentiate between health service information and health management information. The former gives measures of needs and production or indicators on the health of the clients, the demands on the facilities, and the costs involved, whereas the latter is concerned with the management control function and with the development of the planning process -- its purpose being to match resources to needs, to ensure efficiency in service delivery, and to plan and implement locally determined priorities.

Value Content Evolution of IS/IT

An analysis of the information systems situation can be realized considering, in one dimension, the internal and external environments and, in the other, the aspects of efficiency, effectiveness, and integration.

Systems growth and maturation in organizations evolve from an internal to an external focus and, in each environment, systems evolution can be represented as a continuum that goes from the achievement of efficiency, to effectiveness and, finally, integration. Six evolutionary stages of systems development can be envisioned:



In the internal environment, efficiency obtained by the introduction of data processing (Stage 1) evolves to greater organizational effectiveness by the generation of management-oriented information originated from different applications (Stage 2) and, finally, by organization-wide systems integration (Stage 3). At this moment the organization is ripe for an expansion to include the external environment.

In the external environment, efficiency reached by the improvement of communications and access to external databases (Stage 4) , evolves to greater effectiveness by resource sharing with other organizations (Stage 5), and eventually their integration (Stage 6).

These ideas can be formalized by constructing models that reflect the hierarchical operational and basic decision-making framework requirements of the healthcare system:

- At primary care and hospital levels, decision making is concerned with ensuring the quality and appropriateness of the preventive and therapeutic directed healthcare

(patient-centered) functions for a well-defined population, usually expressed in terms of a catchment area or a group of individuals characterized by anthropological, social, or labor categories. Patient and service management is a central concern at this level.

- At the intermediate (district or regional) level, information should be capable of supporting tactical planning activities, health status and service monitoring, resource allocation, health promotion and training requirements for a well defined geopolitical area or for a large aggregation of clients with the same characteristics.

- At the central level, the concern is related to policymaking, planning, and evaluation. Large time series of clinical and administrative data aggregates are needed for long-term strategic planning and for political and intersectoral decision making.

The relationships between the need to know, the framework of action and the level of health service, in relation to the priorities for information needs, can be summarized as follows:

RELATIONSHIP BETWEEN NEED TO KNOW, AREA OF ACTION, AND LEVEL OF HEALTHCARE SERVICE

Categories of Information	Local	District	Central
Health Policy	+	++	+++
Socio-Economic	+	++	+++
Healthcare	+++	++*ag*	++*ag*
Health Status	+++	++*ag*	++*ag*
Type of Decision Making	Local	District	Central
Operational Control	+++	++	+
Management Control	++	+++	+
Policy & Planning	+	++	+++
Intersectoral	+	++	+++
Political	+	+	+++

+++ essential information or decision
++ valuable or appropriate information or decision
+ desirable information or decision
ag aggregate data sets

3.1. What Is Information Planning?

An information plan is an important element to ensure that the information systems to be developed will meet the long-term needs of the organization. It consists of a coherent framework, which establishes:

- Priorities for development in different areas.
- An architecture or framework on which to base the technology.
- A set of strategies to move from the current position toward the future.
- A series of activities to guide the process of transition.
- Definition of indicators to monitor achievement of objectives and products.

An information plan answers questions such as: What are the information needs? What are the future information systems? What resources are required to support them? And how do you make it all happen?

This approach is quite different from the typical approach to planning information systems used in the past. It is not just a portfolio of various information systems projects but a drive to achieve a well-defined and integrated systems goal. Information planning is an iteractive process. At each stage the impact of different alternatives must be considered in terms of resource, cost, feasibility, and practicality. It is not a one-way process, and ideas have to be rethought continuously. There are five stages in the development of an information plan:

- Strategic Requirements Planning
- Information Analysis
- Data Modelling
- Procedure Formation
- Data Use Analysis

The foundation of the whole process is the Strategic Requirements Planning. This attempts to determine the general and specific objectives of the organization and the information needed for enabling them to accomplish their objectives.

The next step is Information Analysis. This is a top-down analysis of the types of data that must be kept and how they relate to one another. It must be done at the central, community, the district or even health unit level. While Information Analysis surveys the types of data needed and provides a broad overview of requirements, it does not contain all the details needed for database implementation.

It is the Data Modelling step that creates the detailed logical database design. This process must be done jointly with information systems technical personnel. The Procedure Formation stage is concerned with the events that change or use the database. It creates logical structures that represent the flow of data and the related events. It is the major input for the development of operational routines and computer programs. This work also must be done jointly with systems technical personnel support.

Data Use Analysis, finally, provides a formal way of collecting and diagramming the usage of data, their paths through the database, volumes, and timing. This is a major technical activity that will direct the information systems physical design.

3.2. Defining Information Needs

Identifying information needs is not an easy task. When we ask someone what their information needs are, they often find it difficult to express them in an organized fashion, or eventually may be able to express them in terms of their own understanding of known ways of providing the information. This is an inherent problem, which must be overcome. Information systems development presents a unique opportunity to reconsider present data-related routines and procedures and to avoid perpetuating existing habits.

One way to define information needs is to establish a team of professionals in each level of the organization and another team made up of central level professionals. Each should develop their own view of the problems, resources, and processes happening in the organization. These are then used to formulate what information is needed to manage the resources and processes and overcome current difficulties. The work from all groups must then be analyzed and will be used as basis for the information needed for information systems specification. Another approach for defining information requirements is to consult with a broad cross-section of all professionals and users. It is only practical to do this in a limited number of health units or districts. One might choose, for example, a large, medium and small district as representative of the needs of all districts.

An information plan is not a standard product. There are many differences between organizational units. Other important issues refer to existing information systems and their specific operational requirements. A complicating factor is related to the variation at local and other levels in the way work is done. Also, when considering information needs we must ask whose needs are being addressed: individual functions, professional groups, and organizational levels

3.3. Role of Requirements Planning and Information Analysis

A key theme in data modelling is that the strategic requirements and the analysis of needed information should be treated as a corporate resource. It is useful to parallel this concept with other resources such as assets and finance. Like other key resources, they should be looked at as essential holdings and as such they require some mechanism for control. The parallel for the information resource is the data administration function -- the data model being a jigsaw or map of all the pieces of information and their relationship with each other. Both requirements planning and information analysis must be tackled at a national level by central level personnel and at the local level by professionals directly involved in the operation of the services. Clearly there is a relationship between information needs and the data model. Information needs are ultimately a reflection of the way management organizes and runs the service and, in consequence, must be supported by an underlying data model.

The data model is not a universal panacea. We may not be able to get all required data and information right at the outset, as it is difficult to specify all our information needs; however, we should strive to get most of it right by getting a broader organizational requirements view through participation of all relevant professionals in the process of information analysis. The less the data model changes during information systems development, the more robust will be the systems based on it. The data model helps in the establishment of the relationships between different sub-systems. This, coupled with the timing requirements and the expected volumes to be processed, provides a basis for developing a structural framework or architecture on which to work out how to use the technology.

4. Information Systems Components

Modern information systems depend on the existence of two components: information infrastructure and technological tools. Information infrastructure relates to demand issues and the technology component is engaged in the supply of technical solutions to the deployment of information systems.

4.1. Information Infrastructure

The information infrastructure Involves the definition of information needs, data and information sources, data capture, and the management of the information function in organizations. Information infrastructure issues are related to two aspects: systems specification and information systems management.

Systems specification relates to the collection of managerial and specialized data and information-related tasks assembled with the objective of ascertaining the details of the demand for information and the possible solutions for the generation of the intelligence required by managers and providers. It is, however, the management of the information function, that poses the greatest liability to health organizations. Information systems management involves the strategic, organization-wide, responsibility for data, implemented information systems, technology management, and information personnel.

A wide array of information infrastructure issues must be dealt with when planning, designing, developing, implementing, and operating information systems, and the following information function management areas must be realistically addressed in each case:

- Objectives and purpose - Specifying the objectives and purpose of the information system at organizational, community, regional, and national levels,
- Information requirements - Distinguishing the types of information required by each health professional and organizational function at each level,
- Organizational setting - Understanding the organizational issues that will have to be resolved as result of the introduction of information systems, including managerial and physical structure changes needed to support the effective operation of information systems,
- Data-related issues - Specifying and monitoring data collection, transcription, processing, and analysis requirements and procedures,
- Processing requirements - Describing reporting requirements and procedures for generating and using processed data and management information in formats understandable by health professionals,

- Indicators - Defining, in practical terms, the most useful indicators of program effectiveness and efficiency and the operations and procedures for generating and reporting regularly on such indicators,

- General technology selection and deployment issues - Clarifying the capacity of the organization to absorb technological innovation and in selecting and deploying the technology, and

- Human resource issues - Determining personnel requirements for operating and utilizing the systems in terms of procedures, equipment, and other inputs. These should include education, experience, training, supervision, and incentives.

The "Business Unit" Perspective

Planning, operation, and management of the information systems (IS) and information technology (IT) components must consider the identification of "business units" in the organization. Such units can be defined as functional collections of individuals, projects, programs, or departments that have a distinct but common (shared) set of activities, products, or clients (customers) that can jointly exploit systems and technological requirements and resources.

The "business unit" concept considers the shared needs of the functional groups as the appropriate level for the development of IS strategies as opposed to a categorization that just reflects or reproduces the departmentalization of the organization or the functions of divisions, units, groups, or individuals.

The organization, in this context, can be seen as a "multi-business unit" entity to which information systems and information technology must respond. Planning of IS/IT services to each "business unit" considers the internal and external demands, the internal and external IS/IT environments, and the existing and future applications. They define the IS strategy (what is needed and their priorities) and the IT strategies (how to deliver services and which architecture and what resources are to be used).

4.2. Technological Tools

Technological tools provide the means to process data into information, communicate data and information, and support the utilization of data and information. Information technology is involved with the development of workable technical answers to the need for effective and efficient operation of the information system. The possible technological options are always dependent of the strategies and areas of concern or application specified by a properly conducted user requirement study – it is, therefore, concerned with the supply of solutions.

There is a broad spectrum of applications that can take advantage of technological resources. They involve the consideration of the desired level of connectivity, communication bandwidth, and area of application.

There are many technological options for each area of application, and the selection of one or other solution must be done in the light of the existing organizational and general technological infrastructure and specific local requirements (Fig. 2). In nearly all occasions, social, organizational, and human resources issues are more significant than technological considerations.

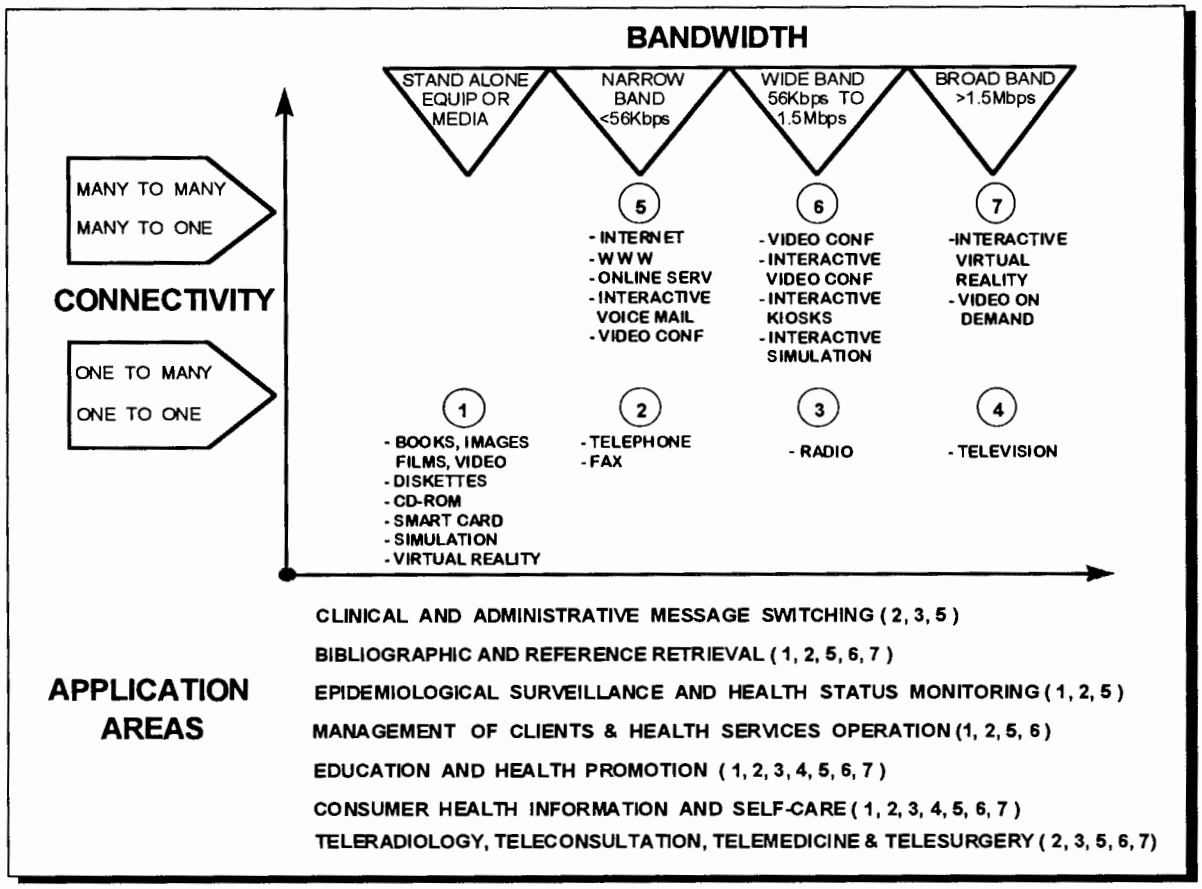


Fig. 2 - Application Technological Options Considering Bandwidth and Connectivity Alternatives

Deployment and utilization of computer-based and telecommunication technologies in health must consider the variety and changing requirements of the health sector; the existence, organization, and efficient operation of an information infrastructure; the level and quality of the telecommunications infrastructure; and the questions associated with the existence of a suitable organizational and managerial environment and matters related to the selection, cost, and implementation of appropriate technology.

Informatics Support to Information Flow and Communication

An essential role of informatics is to enable information flow and communication within the health system and between it and other sectors of society. The view behind the emphasis on primary health care rests on the assumption that it is the basic function of healthcare units not merely to organize health services and improve health coverage at the primary level of care but also to work with all sectors of society to promote health development in the area under their jurisdiction. If this is their basic function, they face serious challenges in the areas of information flow and communication. Since they are not meant to be isolated either from the wider (regional and national) health system or from the economic, social, environmental, political, and cultural context in which health promotion takes place, it is essential that local health units maintain effective channels for information flow and effective communication links with the "external world."

The tendency to decentralize which is present in this view must, therefore, be accompanied by the effort to integrate that which is being decentralized into one overall information and communication network, which includes not only the wider health system (at the regional and national levels) but also the other sectors of society, at both the local and non-local level. It is important to realize that the integration in question is both vertical and horizontal.

Vertically, local health units must be integrated with the regional and national health system, not only in the sense that they must provide the wider systems with information about what is being done at the local level, but, more importantly, also in the sense that, without this integration, it is virtually impossible for them to make effective use of more complex health services located outside their area of jurisdiction and, so, to implant credible mechanisms for patient reference and counter-reference.

Horizontally, local health units must be integrated with other sectorial activities that profoundly affect, and are greatly affected by, the health sector. Economic, social, environmental, political, and cultural factors influence and even determine the conditions of health at the local level. It is impossible to plan and implement effective action at the local level, with the mission of promoting health, in the fullest sense, without establishing an information and communication network between local health units and other sectors of society, which, frequently, also have their local units.

This integration cannot be achieved, today, without informatics. Without computing and telecommunications resources, this kind of vertical and horizontal integration will not take place, and local health units will become isolated islands, without contact with the wider health system and with other sectorial activities, even at the local level.

This integrating task performed by informatics is, perhaps, even more important than the technological support it can provide to health information systems at the local level. In very simple local contexts it may be possible, though not desirable, to have a health information system that is totally independent of computing and telecommunication resources.

5. The Operational Setting of Information Systems

A prerequisite for appropriate introduction of information systems is the clear statement of the objectives of the system, its time scale, and the constraints and possible side effects of the introduction of data collection and other data-related procedures. Data-related definitions constitute, however, the most sensitive issue in information systems specification, implementation, and its utility as a managerial and technical decision-support tool.

The practical operation of information systems is related to six aspects related to the nature of the data involved and how data are processed:

- Formality
- Routine
- Application Contents
- Application Processing Environment
- Systems Configuration
- Data Integration

5.1. Nature of Data and Form of Processing

The first two aspects to identify are concerned with the difference between formal and informal information systems and between routine and non-routine applications. Information systems nearly always deal only with the formal, or logically and purposefully designed and implemented information-related activities.

	FORMAL	INFORMAL
NON ROUTINE	Database integration systems can be of assistance	Technology may provide some degree of support (e.g., Electronic Mail)
ROUTINE	Ripe for automation	When designing formal systems, incorporation should be considered

Table 1. Formality and Routine in Information Systems

Associated with the formal/informal categorization of information systems is the notion of routine and non-routine information. Routine implies that the information is produced regularly in relation to some timetable. A mapping by formality and routine as they relate to the strategic decisions that must be made in the introduction of information systems into the organization can be represented as indicated in Table 1.

The third aspect relates to sources and contents of applications. The provision of healthcare requires, and generates, a wide variety of data and information, which needs to be collected, processed, distributed, and used. Sources of data and information are both within and outside the healthcare infrastructure and located at various distances from the users. One way to view the scope of the possible uses of information systems technology in health is through a categorization of the types of health data and information involved:

- Clinical information - to support clinical functions such as direct patient care.
- Personal and community information - directed to the provision of health-related information directly to the general public.
- Management information - for the day-to-day operation and administrative needs, planning, programming, budgeting, service operation, monitoring, and evaluation.
- Surveillance and epidemiological information - information on the patterns and trends of health conditions and related healthcare measures.
- Knowledge - information readily usable to support a technical task or a health-related decision, such as the solution of a public health matter or the diagnosis of a medical problem, the conduction of laboratory tests, and related proposed treatment.
- Document search and retrieval - documentation, reports, formal publications, and "gray" literature.

Users generally require and generate a mix of these types of information at differing stages of their health-related processes. The collection, flow, processing, and distribution of health intervention-related data and information are key factors for the efficacy, efficiency and economy of the development and operation of health interventions and for the measurement of outcomes.

The fourth aspect relates to the scope of the components of the informational function which demands the existence of competence and infrastructure capable of handling two application processing environments for the information systems:

- An environment characterized by a shared database of collective access and utilization, which maintains the minimum data set necessary for organizational management, statistical reporting, long-range strategic planning, and the support of adequate communication among the different levels of the healthcare system.

- An environment made up by subsystems of predominantly local or departmental use, with databases adequate to the "how to do" of the operational units which may, selectively, feed the common data environment.

The fifth aspect refers to the processing environments required in the development and implementation of functional integration at systems level:

- An integrated common data environment (not necessarily physically centralized as data can be logically centralized in a distributed physical system) in which information originated in different independent functional units is shared by all.

- A distributed environment in which each functional unit manages and processes data of local interest as well as systems of common use.

Finally, the sixth aspect relates to how data integration from different applications is achieved by defining data flows, reporting responsibilities, and integration of data generated and processed at each functional unit around an informational framework that considers three interacting areas for the generation and reporting of decision support oriented information:

- Client-oriented managerial information.

- Financial and administrative.

- Clinical and epidemiological.

Depending on the specific environment and the type of decision or controlling function to be supported, data handling and processing options are subject to a series of constraints.

5.2. Data Sources

The main data sources from which information is produced can be categorized as originating within the organization or obtained from external sources. Data already available, even if unstructured, can often be captured from existing sources, treated, and used by managers to support the planning of the new system. A good strategy is to start by drawing up a list of all the data sources that are available. Examples of such sources are: patient records, documents or forms of clinical or administrative nature used in healthcare units, requisition forms, card files, log books, laboratory forms, and questionnaires.

For each source, an analysis must be done to identify the individual data items included, the person responsible for the capture of data, and its frequency and the observational unit, i.e., the lowest level of aggregation of data. In most instances data are collected relating to different hierarchical levels - for example: data may be collected on whole villages (population characteristics, distance from a healthcare unit, number of cases of communicable diseases); on individual households (type of building, water and sewage); on families (type, occupation of the

family head); on individuals (age, sex, schooling); on disease episodes (duration, signs, management); on service utilization (resources, hours of professionals); and on service operation (costs, equipment, and physical plant maintenance).

Much of the data required to provide information for control is often routinely captured and usually obtained from a single data source. Frequently it requires little analytical work. Other types of information, however, may draw on a variety of data sources in and outside the institution or health district and even the health sector.

Systems Planning Issues

Information needs of administrators and service providers go well beyond the usual statistical and administrative traditional reporting schemes that characterize many health information systems, and must focus upon performance monitoring and target achievement. Also, the comprehensive inclusion of data from primary, secondary, and tertiary health care levels is essential, as the information system must reflect and correspond to the hierarchical decision framework and action mechanisms at every level of the health system.

There are a number of major general issues which must be addressed as part of the process of systems planning, and they must be addressed whether one is in the process of introducing the technology for the first time or in the process of changing or upgrading systems within the organization:

- Ideally, systems should be focused on the concept of a common core system - one to be used by all districts or regions. Other systems may still be developed and used by individual districts or groups of districts. The key to this sort of approach is adequate agreement about the scope and content of the core systems. Within this framework each district or region needs to plan its own priorities and to sequence its own implementation of the core systems. In effect, each district must prepare its own information plan.

- Linkage between different levels of care must be considered - in the community there is need to decide whether to have a common district community health index and what indicators it should manage. At least a minimum data set must be defined, agreed on, and standardized for all levels of care to facilitate data exchange and referrals. Hospitals, because of their complexity, will require a number of specialized clinical modules.

- In all administrative areas, there is need to consider issues such as whether personnel systems, payroll, general accounting and procurement systems, and patient accounts -- they should be deployed at the institutional, district, health region and national levels and the relationship between new systems and the eventual introduction of budgeting at the local level must be clearly defined.

- Frequently there are excessive expectations regarding the role of automation - which may be erroneously perceived as a solution for problems that are of organizational or behavioral nature. A successful installation does not necessarily mean that one has working technology. In fact, there are many instances of institutions that have the technology in place, but the equipment is not being used to its optimal capabilities.

- Nearly all organizations face the same systems deployment problems - proliferation of equipment, incompatibility at hardware or software level, and generally low sophistication of user knowledge of the system must be considered early in the planning process.

5.2.1. Provider and Procedure-Oriented Sources

Specific provider- and procedure-oriented information systems have a different scope as they are, as a rule, concerned with the utilization and the financial aspects of health delivery. They are generally imposed from the top administrative level and, in most cases, are directed to the reimbursement for services provided and financial control. They utilize standardized data sets that

typically record patient identification, reimbursement category, length of hospital stay, diagnostic data, and the utilization of special services.

One critique regarding most provider- and procedure-oriented information systems relates to the fact that they give little attention to the lower echelons of the healthcare structure in terms of supporting service operation and improvement. Most databases are highly aggregated and have minimal value to decision-makers, at individual or community level, or as a source of support information for local healthcare action, surveillance, and monitoring. They are also inappropriate to unit managers or local health service administrators and, frequently, the time lag between collection and analysis is far too long.

Requirements of Primary Care Physicians

Computers in general practice are now the norm rather than the exception, and it seems that they are here to stay. However, computerization is still in a relatively early stage, and many improvements can and need to be developed. It is important that at this stage General Practicioners not already gaining some familiarity with this technology should do so before it advances much further. The table below summarize the results of a survey conducted in 1992 in the East Surrey Health Authority Area (UK).

The most common applications in use were of the administrative and basic clinical kinds, such as patient registration, basic repeat prescriptions, age/sex registers, and screening and recall systems. The applications mostly used for development were automated recall and business and accounting, suggesting that GP's attitudes may be changing regarding the potential of computers in practice management. Various remote links were also in high demand.

Applications used in computerized practices (%)

Patient registration	100
Basic repeat prescription	100
Age/sex registers	95
Immunization/screening recall	95
Cervical screening recall	95
Word processing	73
Disease registers	68
Defaulter identification	64
Disease surveillance	54
Intelligent repeat prescription	36
Business and accounts	32
Medical audit	32
Results filing	27
At-risk registers	23
Full medical records	23
Patient instructions	18
Desktop publishing	4
Medical education	4
Pharmacy link	4

(*excerpted from* Brit J Healthcare Comp, Nov 1992)

The aggregation or averaging of data over large groups may hide variations and can conceal important information, such as that related to the poor quality of primary data and failures or inadequacies of specific health program components. Many health information systems of this type produce only highly aggregated data directed to central bureaucratic control and supervision.

5.2.2. Patient-Oriented Sources

A large amount of information is produced and needed where people live and make contact with the health services. There is a growing trend in developing event-based patient-oriented information systems, as the basis for unit or regional information systems. Such systems demand the extensive training and continuous collaboration of physicians, nurses, and other direct care providers. Focusing on local information and local decision making and action involves finding answers that cannot be provided by information systems directed to central planning and supervision, typically based on highly aggregated data.

Patient-oriented information systems consider clients as the central observational unit and reference of the information system. They can provide production, utilization, diagnostic, and epidemiological information of great importance to managers and direct care professionals. The major problems in designing such systems are related to:

- the definition of the data set to be processed,
- the integration of unobtrusive primary data capture instruments into routine health practice, and
- data procedures that are acceptable to direct healthcare professionals.

Common specifications, data dictionaries, and the agreement upon a minimum data set to be utilized by all healthcare units are complex issues that must necessarily involve a variety of professionals. Most existing or planned patient-oriented information systems, unfortunately, are designed to provide information only about the actual clients of health systems, failing to give information about illness in those who do not have access to institutional healthcare. As an alternative, approximate information of this latter kind, can be obtained, in many cases and with some degree of difficulty, from national, regional, or local population surveys, if they exist, or from registries of death at Vital Statistics Offices.

Most current statistics bearing on health services tend to be practice, clinic, or hospital-based and, in the absence of the person's place of residence and other identifiers, it becomes impossible to generate population-based statistics. This is a serious deficiency and a major impediment to the use of much existing health information for setting priorities in strategic planning.

5.3. Types of Data to Be Collected

It is possible to establish some general basic principles that should guide the definition and acquisition of data for a health information system:

- Data, as much as possible, should be person-specific - This means that collected data should be able to describe health problems, attributes, events, activities, services, and outcomes in terms of numbers of individuals possessing them.

Although it may sometimes be desirable and even possible to count all persons in a population, sampling methods are frequently adequate and more accurate for making estimates, and usually much less expensive.

- Data should be population-based - The system must have the capacity to make comparisons within and across geopolitical or administrative boundaries. For the equitable distribution of resources on the basis of need, politicians and planners require such comparisons. The information, ideally, should be provided as numbers of persons, which generally is a more useful form of information display than a rate.

- Data should be period-specific - That is, the system must have the capacity to relate persons and places to periods of time. The recording method employed should be related to the decisions to be made and the geopolitical levels involved. For example, when monitoring accidents requiring emergency service it may be desirable to record time of day, whereas the monitoring of seasonal epidemics may require only the identification of the day or week.

- Collected data should consider the need for time series and trend analysis - Comparisons over time within and among geopolitical jurisdictions are needed in order to determine whether progress is being made towards specified objectives. The frequency with which comparisons are made should be related to the expected rate of change in the phenomenon being observed.

- Data should be problem-oriented - The system must start with the identification, labeling, classification, and counting of the people's perceived health problems and the fundamental task of the healthcare establishment is to assist in the prevention, resolution, or management of these problems. There is little virtue in making a medical diagnosis, and even less in recording and counting diagnoses, unless corrective action ensues and the individual patient or the population is effectively helped.

- Provider-specific data should be captured -The system must have the capacity to identify where and by whom a service was provided. The effective deployment of resources implies the requirement that they should be related to the distribution of health problems over space and time. To monitor these relationships, as well as the quality and benefits of care, the individual and his problem must be linked to the provider, and all three to a population base. This approach will help to ensure that simple, treatable problems are managed at the lowest appropriate levels, at the earliest possible time, and with the least expensive use of resources and not vice-versa, as frequently happens.

- Data should be procedure or process-specific - The system must have the capacity to identify the forms of intervention used, in order to enable monitoring of the distribution, quality, and appropriateness of care, and the use of resources and incurred costs.

- Data collection scheme should be practical - Data to be processed should be as easy to acquire as possible and able to serve multiple purposes. The system should not sanction the acquisition of any data for which there is no clearly defined need. A sound rule when specifying the data element that should go into a system is: When in doubt, leave it out.

Level of Detail of Captured Data

In most settings throughout the world, approximately twenty common clinical problems are known to be responsible for about half of the demand made on health services, and about half of those twenty problems are associated with pain. If the list is extended to the fifty most common problems, the frequency of presentation of a given problem tends to decline rapidly to less than one percent of patient visits.

Balance is needed both in selecting the data to be acquired and in determining the precision of the estimates to be made. In many instances, relatively low-precision estimating techniques may be adequate and should serve as the model rather than striving to achieve the precise bookkeeping practices that are more appropriate to a banking or commercial application setting. A word must be said against the tendency to collect large amounts of data, not always relevant. Codification is inevitably a slow process.

It is more probable that advances in knowledge will be fostered by clear thinking than by rapid computing or indiscriminate storage of massive amounts of data. Contributions to critical thinking are more likely to prove to be of human, clinically beneficial, and cost-effective nature, than consequent to investments in technology not yet evaluated, inappropriate precision, and expensive hardware. It is better to be roughly accurate on a timely and useful manner than unduly precise, late, and irrelevant.

6. *Socioeconomic Consequences of Informatics in Healthcare Systems*

The socioeconomic impact of Health Informatics on health organizations and direct healthcare involve the following five key dimensions:

- national healthcare structures,
- organizational changes,
- equitable access to services,
- quality and cost, and
- impact on the future organizational development of health systems.

6.1. Impact on National Healthcare Structures

The introduction of informatics technology facilitates innovation through creative forms of health systems organization and healthcare delivery services. Hitherto difficult if not impossible, strategic integration of service provision can become a reality as well as the operationalization of new institutional and financial arrangements.

The use of advance telecommunications support and electronic data interchange (EDI) networks permits the integration of professionals, new direct patient care roles for non-physicians, on-line interactive consultation of distributed patient data and teleconsultation, and decision support for providers, and continuing professional teleducation. Informatics can initiate and support changes in the financial arrangements through which healthcare is administered, especially in relation to reimbursement procedures and protocols, and the expansion of market-led purchaser-provider relationships supported by the increased use of integrated hospital and ambulatory information and electronic patient record (EPR) systems.

These technological, institutional, and economic innovations are reflected in the trend towards service integration, represented by the standardization and interconnection of technological platforms and application environments and by the promotion of the incorporation of unified and standardized health records. Systems integration, at the same time, permits a perhaps more structurally significant movement towards the decentralization and regional integration of coordinated service delivery to primary networks at regional and community levels.

6.2. Organizational Effects

Informatics requires the transformation or creation of new work activities, roles, and skills associated with deprofessionalization of many tasks. Redundancies may result in the areas of secretarial, support, and technical staff, and the technology has the potential to assist the delegation of authority for many routine clinical care tasks to nurses and other paramedical professionals. Reorganization of procedures related to grading and accreditation of skills, medical classification, financial, and administrative protocols may require profound institutional changes, extensive retraining, and compensatory structural changes, for example in terms of job description

and remuneration. The introduction of new technologies invariably creates commotion within the established work culture and within the organization, and the informatics innovation may result in the establishment of a self-contained organizational subsystem within the wider organizational context.

The Global Village Is Diverse, Information Technology Is Universal... But Where You Live Plays an Important Role in How the IS Stage Is Set

In addition to covering key Chief Information Officer (CIO) concerns in North America, a recent study on "Critical Issues of Information Systems Management" included feedback from IS executives at influential organizations in Europe (121 respondents) and Asia/Pacific (154 respondents). While the three geographic regions exhibit similarities in many areas, there are interesting differences among their responses to a number of key questions.

For instance, the top two IS issues for all three regions are the same: "aligning IS and corporate goals" and "organizing and utilizing data." However, the remainder of the top five are for the most part quite different. In North America, "using IT for competitive breakthroughs," "capitalizing on advances in IT," and "connecting to customers, suppliers or partners electronically" rounded out the top five. In Europe, "instituting cross-functional systems" tied for second, "cutting IS costs" was fourth, and "connecting to customers, suppliers or partners electronically" ranked fifth. In Asia/Pacific, "integrating systems" was third and "instituting cross-functional systems" and "creating an information architecture" were tied for fifth.

In the systems development arena, a greater percentage of Asia/Pacific respondents are focusing on legacy system replacement (29 percent) than are their European (17 percent) and North American (20 percent) counterparts. And while customer service, sales, and distribution are the top three functions for which new systems are being developed in North America and Europe, Asia/Pacific systems development initiatives are geared toward supporting customer service, finance, and distribution. Finance ranked eighth on the list for North America and fourth for Europe. As far as development approach is concerned, Europeans are more likely to custom-build systems, whereas Asia/Pacific lags behind both Europe and North America in minimally customized package implementation.

In terms of new system costs, Europe appears to be outspending North America and Asia/ Pacific -- most likely because of Europeans' propensity toward custom-built systems. Furthermore, while North America and Asia/Pacific respondents rated increased efficiency as the top business impact of their new system, Europeans rated it third. Finally, although all three regions had a high percentage of respondents noting current outsourcing of some IS activities, Asia/Pacific led North America and Europe by 13 points in the percentage of respondents planning or considering additional outsourcing this year.

6.3. Equitable Access to Services

Positive contributions of Health Informatics regarding the improvement of access to healthcare results from the expansion of geographical coverage to under-served populations, the devolution of healthcare to individuals, the facilitation of interactions between service providers, the dissemination of knowledge and expertise, the systematic monitoring of health conditions at the community level, and reshaping of the spatial pattern of healthcare resources and facilities by regionalization and municipalization of service management and provision.

6.4. Quality and Cost Impacts

The main impact areas in terms of quality relate to better access to patient data, faster and more accurate diagnosis, improvement in the level of professional expertise, reduction in the rate of

patient referrals, increase in access and choice regarding points of service delivery, and better planning and resource management. Effectiveness and efficiency gains result from time savings in documentation and management procedures, communication of diagnostic results, standardization of procedures and protocols, reduction of referrals and travel of clients and providers, elimination of tasks and record duplication and transcription, and increased user satisfaction.

The costs of the technology deployment and operation are, to a great extent, dependent on the institutional arrangements governing the model of healthcare system and informatics development and implementation. At present, the cost of practically all implementations are borne by intermediaries or providers who purchase informatics technology and applications, products, and services from suppliers through direct acquisition or subscription payments. In many countries, subscription, or a combination of direct purchasing of capital infrastructure followed by subscription to a service, is increasingly the norm.

The effects of the different possible institutional arrangements governing development and implementation are complex. Funding arrangements generally involve multiple partnerships which vary according to the specific applications environments being developed and large scale infrastructure programs involving the provision of integrated ambulatory and hospital information and electronic patient records systems are heavily subsidized by national governments or regional health authorities. Although national subsidies have been important in stimulating market development, commercial investment is highly differentiated and under-represented in large information systems and primarily concentrated in generic application areas: EPR, smart cards, and departmental applications.

Problems in the assessment of cost-benefit relate to the difficulty in gathering significant data in innovative and evolving domains and absence of recognized evaluative methodologies. Real costs of health informatics are determined by a number of factors, notably the funding arrangements in place, level of subsidies, nature and extent of displacement costs (for example, the cost related to the diversion of existing personnel to new tasks associated with the deployment of the new technology), and the extent of cost-sharing in situations where healthcare costs are mixed with other activities (such as basic sanitation and education, for instance).

6.5. Impact on the Future of Health Systems Organizational Development

Case studies of implemented applications, specially in the European Union, permit the identification of the following key constraints that must be addressed in the organizational development of health organizations if the informatics technology is expected to flourish:

- Technical - Constraints to the development and implementation of applications are basically related to obsolescence of equipment and the requirement of constant upgrading, major integration problems regarding inter-operability in a multi-vendor environment, variable quality of technical outputs, telecommunications infrastructure, and bandwidth restrictions to data transmission.

- Financial - Lack of funding for development work outside the mainstream areas of generic applications, hospital information systems and EPR, lack of knowledge of market opportunities and in the preparation of a "business case" for Health Informatics developments, and the serious problems with the legal and financial structures of healthcare.

- Policy - Lack a national set of policies and norms regarding information technology and failure to integrate the different visions of Health Informatics as they relate to the health system model, and "islands" of innovation typically associated with centers of excellence isolated from national, regional, and local schemes.

- Standardization - Problems over standardization have long been identified as a major constraint to development and implementation, the main problems being related to data-related, institutional, and organizational issues, rather than technical ones.

- Organizational - Organizational constraints are centered mainly on problems to do with the reengineering of work patterns and procedures. Case studies have shown instances whereby the introduction of informatics significantly increased workloads for staff and direct healthcare professionals, problems regarding retraining, physical data security, and confidentiality of patient-related data.

- Cultural - Professional resistance to change in a profession characterized by hierarchy and clearly demarcated roles is a major obstacle resulting in unwillingness of professionals to collaborate in recording and exchanging patient data. This lack of interactivity is paralleled in terms of user involvement and top-down imposition of innovations.

Redefining Nursing Continuing Education (CE) Delivery

Just as technology is transforming the delivery of education, the Internet and advanced telecommunication applications are changing the "face" of CE and the connotation of "lifelong learning." As late as the mid-80's, a discussion of computer applications in nursing CE focused on the "timely" transition to microcomputers as tools for the enhancement of managerial tasks for increased productivity. Even as recently as 1990, there seemed to be "time" for those providers who were "slower to adopt innovation" to "catch up." Now, the CE provider who does not integrate the microcomputer and advanced telecommunications as an integral component of its delivery modalities may be by-passed rapidly by an educational or commercial competitive unit that is able to utilize the communication medium, mergers and partnerships, enterprise, and individual lifestyle and learning patterns that will epitomize the CE unit of the 21st century.

As with the "re-engineering" of nursing education, the "re-engineered" delivery modalities of evolving CE entity might now best be conceptualized on a continuum from the traditional mode, that is time and place dependent, to a mode of synchronous and asynchronous data and advanced telecommunication. Delivery methods will need to be selected according to the target populations, content, and situation. The health-care educational provider may discover, as in other industries, that a combination of distance and residential offerings will be the most successful medium for the delivery of CE to the progressively more "information and technologically savvy" lifelong learner of the 21st century.

A number of national and world-wide trends are propelling rapid changes in the delivery modalities and types of emerging providers for health-care CE. Examples of these advanced telecommunications applications of CE opportunities for health-care personnel are becoming more prevalent in the literature and the pattern of CE marketing, and delivery evolution can be seen readily on the Internet. Continued program success and viability will belong to the individuals and organizations who are able to conceptualize and envision the positive transformations and opportunities that can occur from the evolving paradigm of education.

(*excerpted from* Carlton, K.H. (1997) Computers in Nursing 15(1): 17-18)

7. Technology Appropriateness Issues

Technological appropriateness is central to this discussion. Concerns regarding the development and implementation of applications consider approaches and technical solutions that:

- Benefit clients by improving access to services and quality of care while preserving equity;
- Best support the information and knowledge needs of health professionals, managers, researchers, and client requirements;
- Promote the development of medical and organizational infrastructure most appropriate to take advantage of the methods and technology of telecommunications and computing;
- Manage the knowledge content of applications and the role and responsibilities involved;
- Foster the multidisciplinary approach and strategic perspective required to take full advantage of applications;
- Provide answers to the variety of needs and implementation environments found in Latin America and the Caribbean; and
- Support the establishment of policies and market foundation to enable the future growth of Health Informatics.

Notwithstanding the fact that the lack of information and information systems has been shown to be one reason for inequalities of access and care quality among individuals and society groups, the inappropriate implementation of Health Informatics may widen the gulf between the haves and the have-nots. This is a serious concern of ours, especially when one considers the masses of poor and illiterate that exist in our countries.

Many new commercial health information products are being marketed to health plans, healthcare purchasers, and individual consumers without formal evaluation of either effectiveness or health impact. The exponential growth of health information on the Web, the marketing of newer products before content validation and adequate field-testing is conducted, and the increasing use of health decision-support applications raise serious concerns regarding the accuracy, quality, and health impact of information systems and application programs. Social values, perception of illness, and patterns of client-provider interactions differ among different countries, inside the same country, and between social classes. Language remains a major hindrance to overseas telemedicine applications. Beside the official language, there may exist native and ethnic languages or dialects which create serious difficulties when establishing a program. Validation of knowledge content to local problems and practices is extremely important. It is, therefore, possible that inaccurate or

inappropriate health information will result in harmful decisions such as prescribing inappropriate treatment or delaying healthcare-seeking behavior.

What do Users Want?

- Functionality
- Reliability
- Convenience
- Cost

What happens when competing products both offer more functionality than the market demands? How do customers decide which competing product to buy?

In my research, it appears that when the market's need for improved functionality has been satisfied, customers will choose the product and vendor that is most reliable. When this happens, those companies that follow a strategy of offering superior reliability earn substantial price premiums in the market, compared to competitors who continue to push meaninglessly up-market along their functionality trajectory.

The same dynamic of overshooting market needs can occur in the reliability dimension, however. When the alternative products are all reliable enough, the basis of competition amongst products amongst products typically shifts again to convenience: Customers will choose those products that are most convenient to use, from those vendors that are most convenient to deal with. Again, competitors begin to improve their products, this time by offering ever-better levels of convenience. This pattern is pervasive, regardless of industry. By some counts, over 80% of the growth in the computer hardware industry, and nearly all of the growth in the foods industry, has come from companies and products whose fundamental value propositions have been reliability and convenience, not functionality.

It often happens that the trajectory of improvement in convenience eventually overshoots the market's needs as well. Typically at this point, customers will choose the product whose cost is lowest. This pattern of competition has been observed and measured in industries as diverse as computers and disk drives, diabetes care products, hydraulic excavators and executive education. In each case, the shift from functionality to reliability, to convenience and finally to cost, has been triggered when multiple competitors have overshot the market need along the reigning dimension of competition. Very frequently, it is newcomers to the industry who see the opportunity to compete on a different dimension, while the established players overshoot the market, targeting the performance needs of a shrinking minority of the most demanding, vocal customers at ever-higher tiers in the market.

(*excerpted from* Computerworld Leadership Series, January 1997)

Technology assessment must be a significant component of any project and is too important to be left to technologists, medical specialists, and service providers alone, as they have a tendency to focus exclusively on innovations with narrow applications and, frequently, are affected by "technological optimism," a condition in which potential benefits of technology are stressed and potential problems are minimized.

Project planning should avoid the common approach of searching for a problem that fits the existing technology in favor of determining the appropriate health problems that could be helped by technology. Needs assessments duly consider all implementation environment factors and constraints as well as the requirements and expectations of the providers and patients. Technology ideally should exist as an almost invisible overlay to clinical and managerial activity. Perhaps more crucial to effective implementation on the local level is the appropriateness of

content and information "usability". Maintenance of knowledge contents and the disparities of alternate sources of health information present major problems for the end-users.
Many projects have shown low rates of utilization. Managerial and acceptance issues play vital roles in both program effectiveness and utilization of services. Leadership, individual commitment, official "buy-in" of the project and its ideas, and organizational and training factors directly relate to the ultimate success or failure of many programs. To ensure long term viability, early adopters should be encouraged to become "champions" of the program. Local providers and their assistants must accept and actively support the deployment of applications. Systems must easily integrate into routine clinical practice and interfaces should not be burdensome and should be as little intrusive as possible to the user.

Financial projections, risk management, and continuous evaluation feed-back represent key elements that must be inherent to any program from the initial stages onward. Evaluation criteria should be constructed considering:

- Fulfillment of defined needs,
- Long term sustainability,
- Demonstration of organizational support,
- Acceptance and utilization of health professionals, and
- Ability to track data on costs, quality, efficiency, and outcomes.

A Historical Perspective of Telemedicine

Telemedicine techniques have been under development for nearly 35 years. Wittson and colleagues were the first to employ interactive television (IATV) for medical purposes, in 1959, when they used a microwave link for telepsychiatry consultations between the Nebraska Psychiatric Institute in Omaha and the state mental hospital 112 miles away. In the same year, Jutra pioneered teleradiology in Montreal, Quebec, by transmitting telefluoroscopic examinations over coaxial cable. In the 1970s and 1980s, limited telemedicine projects were instituted at several sites in North America and Australia, including the Space Technology Applied to Rural Papago Advanced Health Care (STARPAHC) project of the National Aeronautics and Space Administration (NASA) in southern Arizona, a project at Logan Airport in Boston, Massassuchets, and programs in northern Canada. All of these projects used some form of video (black-and-white television, color television, "slow-scan" transmission) to enhance the most basic unit of telemedicine equipment, the telephone. Grigsby and Kaehny recently reviewed telemedicine activities undertaken prior to 1993.

With the exception of the 20-year old telemedicine program at Memorial University of Newfoundland, St John's, none of the programs begun before 1986 has survived. Although data are limited, the early reviews and evaluations of those programs suggest that the equipment was reasonably effective at transmitting the information needed for most clinical uses and that users were for the most part satisfied. However, when external sources of funding were withdrawn, the programs disappeared, indicating that the single most important cause of their failure was the inability to justify these programs on a cost-benefit basis. Other issues, such as limited physician acceptance, played a less definitive role in their demise.

Rapid changes in technology and health care make it difficult to predict the role of telemedicine in future practice. Technology trends suggest that, within the next few years, health care providers will be able to see patients at remote sites by using a desktop workstation or laptop computer in a mobile, wireless configuration. Clinicians will be able to select interactive video and store-and-forward modes as needed. Simple, intuitive software shells will allow seamless access to pertinent patient records, radiographs, pathology slides, pharmacy information, and billing records. Instant access to on-line libraries of medical information, diagnosis and treatment algorithms, and patient instructional materials will be available. Referral to specialists and allied health personnel will be done by computer-based scheduling. Patient information will be stored in archives that can be accessed by authorized medical personnel anywhere in the world. Privacy and security will be provided by encrypting data and restricting user access by means of passwords.

The medical community should treat telemedicine as both a means of communication and a new diagnostic or therapeutic modality. Proper skepticism and caution should be matched by decisive implementation when there are well-defined opportunities to serve distressed populations. Research into safety, efficacy, cost-effectiveness, and satisfaction must be a high priority, and providers should be kept up to date with telemedicine developments. Using the lowest cost and most conventional technology that will meet clearly identified needs also seems prudent. Finally. decisions about large-scale implementation should be based on the services to be provided rather than the technology used. Telemedicine systems are simply one more method of providing needed medical services to patients and other medical care consumers.

(excerpted from Perednia, D.A. and Allen, A. JAMA Vol 273. No. 6, pg 483-488, 1995)

8. Challenges in the Deployment of Health Information Systems

A number of obstacles constitute major hindrances to the deployment of information systems in the health sector; some are directly related to the nature of the sector, others to market characteristics.

8.1. Constraints Related to the Health Sector

Although the healthcare sector produces massive amounts of data and the recording and processing of such data occupies much time of health professionals, only a very limited range and quantity of clinical and administrative data are processed into information. The variety of potentially useful information that could be generated from those data is therefore not fully utilized because, in most instances, there is no acceptable unobtrusive mechanisms in place to simplify data capture, to process data into information, and to make information available to the interested individuals and organizations in a timely manner and in a format that is easily communicated and understood.

The health sector is lagging behind in the adoption of computer-based and telecommunications services when compared to other segments of the society. Despite the proliferation of applications, and the size of the health information market, the range and permeation of applications is still limited. In the U.S. it is estimated that the health information and technology market is close to $13 billion, representing around 1.3% of the total healthcare spending.

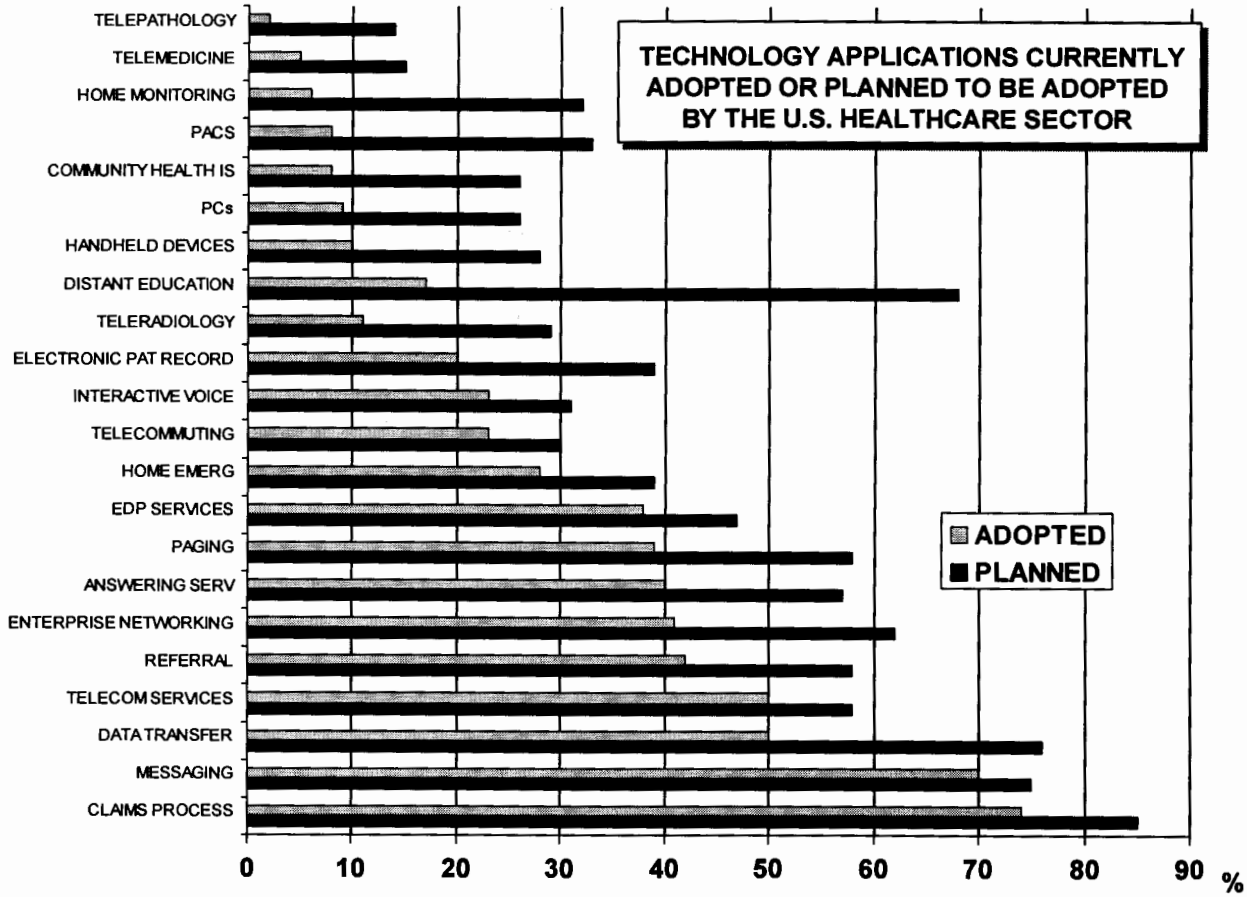
Many factors contribute for this state of affairs: lack of adequate solution packages; conflicting or redundant standards, component functionalities and data definitions; technology platform-imposed development; irregular or limited investment; and the lack of decision support functions in general applications. This situation has been compounded by the fast paced changes and requirements brought by health sector reform processes.

8.2. Constraints Related to the Characteristics of the Health Information Market

There are a number of business challenges that trouble the health information industry. The industry is fragmented, with poor market distribution channels, and every firm entering the field does so under great risk, since there are few market studies to support a strong business case. While there is a demonstrated need for turn-key systems and there is a very large number of providers -- in the U.S., represented by more than 900 companies small and large -- but there are many difficulties in deploying integrated information systems assembled from multivendor components. The great diversity of user needs is a major problem, it is not that commercial products are not appropriate, it is that somewhere between the specification and the systems acquisition new requirements became evident and were not incorporated in the final user product.

8.2.1. Diffusion of Applications

Even in industrialized societies, as is the case of the highly evolved U.S. healthcare setting, most of the technology currently used corresponds to simple applications: claims processing, message switching, data transfer, traditional data processing and enterprise networking. The percentage of organizations or providers using advanced resources such as electronic patient records, telehealth applications, hand-held devices, community health information systems and even personal computers is rather limited (Fig. 3). Advanced applications of telecommunications are still in their infancy and potential users have little knowledge or experience in the field. Appropriate tools for measuring cost effectiveness and health benefits have been rarely used in planning new information systems.



SOURCE: CENTER FOR HEALTHCARE MANAGEMENT INFORMATION, ANN ARBOR, 1994

Fig. 3 - Technology Applications Adopted or Planned in the U.S. Healthcare Sector

Changes in technology, management and business objectives can wreak havoc on outsourcing contracts -- a 1997 Dataquest study of 130 corporations showed that 53% of information technology outsourcing deals and 73% of business process outsourcing deals were renegotiated or being renegotiated -- this is associated with increasing costs and delays in application deployment.

8.2.2. Adoption of Standards

Sharing and communicating information is a fundamental task in modern medicine. The healthcare system of the western world is based on teamwork of professionals who participate in the care of patients. Exchange of information (not just data) requires the communicating parties to agree on a communication channel, an exchange protocol, and a common language. The language includes an alphabet, words, phrases, and symbols that express and assign meaning, understood by all. The question of standards is very important and still unresolved and stems from political, commercial, and technical differences.

The adoption of common standards is a must for cost-effective exchange of information between individuals, groups, and applications but, despite progress in recent years, the lack of standards remains a hindrance to technical development and an obstacle to extensive national and international collaboration. Computers and communication systems improve the sharing of healthcare information by overcoming the limitations imposed by the dimensions of time and location. Agreeing on standard data exchange protocols and domain specific vocabularies and codes is probably our greatest challenge. However, standards alone are not sufficient -- acceptance of the standards by the healthcare professionals, verifications in clinical environments, and implementation agreements by the medical informatics industry are essential. Ideally, we would like to see a single industry-wide model adaptable to each implementation.

8.2.3. Multiple Stakeholders

Exploiting the power of a national health information infrastructure is a complex challenge. It is not simply a matter of connecting all participants. Major gaps and incompatibilities in existing healthcare information systems make the creation of an effective information infrastructure impossible without the collaboration of many stakeholders.

Experience suggests that identifying the stakeholders and their motivations, and involving them throughout the initiative is critical to the success of projects. Consistent with any other group effort, stakeholders, and their roles, vary throughout the different stages of a project: identification of a problem, needs assessment, evaluating alternatives, implementation, and ongoing evaluation. Perhaps somewhat differently from many other collaborative efforts, it is the variety of potential stakeholder groups that distinguish health information projects.

There is a recognized need for cooperation among all the stakeholders. Public and private stakeholders include: payers, providers (individual health professionals and healthcare organizations), consumers, developers, service and equipment suppliers, funding agencies,

researchers, non-government organizations, communities, and governments at the local, regional, and national levels. This variety of interests stems from the complexity of the healthcare system, the penetration of the telecommunications industry into healthcare, and the recognition that consumers, payers, regulators, and providers are stakeholders as well. Each group has its own special interests, needs, circumstances surrounding their interests, and motivations that must be considered during every stage of the process. Coordinating efforts across these multiple stakeholders is difficult (Table 2.)

Table 2. Stakeholder Groups and Possible Goals for Participating in Health Informatics Projects

Stakeholder Group	Possible Reasons for Participation
Governments (local, regional, national)	Political pressure, social demand, promote equity, improve health and health status of individuals and communities, facilitate regulation, standards, control services provided, monitor health status and prevalence of health conditions
Public Healthcare Organizations	Maximize and improve access and quality of services considering the limitation of resources, reimbursement for services, monitoring services and providers
Healthcare Professionals	Optimize quality, facilitate professional activity and access to knowledge
Non-Governmental Organizations	Social demand, philanthropy, improve health, development of standards
Private Healthcare Institutions	Competitive advantage, support operations, provide quality care, improve image and client satisfaction, reimbursement, and monitoring of services and trends
Academic Institutions	Research and advancement of scientific and technical knowledge, education, and training
Population/Individuals	Service access and quality, increase knowledge and participation in health decisions
Industry Suppliers	Research & Development, market share, profit
Other Entities (e.g., Banks, Business)	Social demand, philanthropy, image promotion

8.2.4. Market Issues

Identification of the primary market and consumers, barriers to market entry and business development, and marketing strategy are highly region specific. Even in the same country there will be marked differences regarding needs, infrastructure, language, and culture. Technology service companies, consultants, integrators, and providers must understand the specific nature of healthcare markets.

A Vendor on Judging Vendors

Thomas R. Madison Jr., group president of outsourcing vendor Computer Sciences Corp. in Falls Church, Va., has participated in approximately $12 billion worth of outsourcing deals involving such companies as J.P. Morgan, DuPont and CNA Insurance. He recommends that outsourcing buyers investigate the following points about their prospective vendors:

- How high is the vendor's level of interest in your outsourcing needs?
- Does the vendor show the flexibility to respond to business and technology changes?
- Is it committed to the outsourcing industry? Is it financially secure?
- How diverse are the vendor's employees' skills?
- What breadth of professional services does the vendor offer?
- Does it have relationships with other outsourcing suppliers?
- Is it willing to share risk?
- How good is the vendor's knowledge of your industry?
- Do existing customers trust the vendor?

Five Questions to Ask Yourself Before You Outsource

- What are your core competencies?
- How does your IT organization help enable corporate strategy?
- What IT skill sets will you need in the future?
- Can a vendor provide your current service levels at a lower or variable cost?
- Does upper management support your outsourcing decision?

Five Questions to Ask Vendor References

- How did you choose the vendor?
- How has the outsourcing relationship helped achieve your business goals?
- In what ways has the vendor met and not met its commitments?
- What value proposition did the vendor sell you versus what it ultimately delivered?
- How has the vendor handled change and conflict?

(*excerpted from* CIO, pg 58, April, 1997)

Many solutions involve unrealistic scenarios and many vendors describe their products in terms not relevant to the health sector or fail to perceive that the fundamental basis of healthcare is the relationship between the patient and the healthcare professional. Technology must enhance this relationship, not encroach upon it. The key to entering the health market is to understand the need to adapt or modify the technology to serve the real and important needs of providers and patients. Participant buy-in (government, academic, private sector providers, and telecommunication and information industry partnerships) is fundamental for success. The allocation and evaluation of costs, time, and responsibilities as well as potential litigation issues require consideration when transferring applications developed for other implementation environments. It may not be a trivial

task to locate international expertise or hire appropriately skilled counterparts at the country implementation environment. Healthcare personnel must exhibit an appropriate level of expertise and knowledge of the possibilities of information systems and information technology to be able interact with information systems professionals. Local realities of one city or province may not apply to another locale.

Joint investment and development involving users, governments, academic and financing institutions and agencies, technical cooperation agencies, and industry interests are seen as necessary. Partnerships with the informatics industry are absolutely fundamental and, in the case of general informatics tools, the industry practically drives the solutions. A concerted effort is needed to secure a clearly defined and specified partnership with the informatics industry at the global and national levels aimed at appropriate and cost-effective tools.

A retrospect of project experiences show that many externally funded projects collapsed upon funding termination. This fact demonstrates that all projects need justification in terms of cost-benefit and long-term financial sustainability. This further indicates that spreading the financial risk across several stakeholders may be appropriate as cost-sharing increases overall awareness, utilization, and long term potential for success.

8.2.5. The Responsibility of Governments

Governments should focus on their role as sponsors of basic scientific and technological research and have the responsibility for assuming an active leadership role in educating the medical community and in coordinating and encouraging a more rapid and effective implementation of clinically relevant applications of wide-area networking. Policy and regulatory norms are needed but if approached rigidly they may inhibit and complicate the delivery of innovative technologies and applications while more attention should be paid to how technical ideas are made accessible to potential users. The development, implementation, and testing of standards as well the responsibility for narrow problem-solving and specific applications should be left to the institution with the problem.

There are five areas for possible government involvement:

- Convening groups for the development of standards;
- Providing funding for research and development;
- Ensuring the equitable distribution of resources, particularly to places and people considered by private enterprise to provide low opportunities for profit;
- Protecting rights of privacy, intellectual property, and security; and
- Overcoming the jurisdictional barriers to cooperation, particularly when there are conflicting regulations.

8.2.6. The Role of the Non-Governmental Sectors

The private sector already recognizes the importance of these matters and will, when the market demands it, adopt and enhance the telecommunications systems that are needed to produce effective uses of the Global Information Infrastructure by the healthcare community. Knowledge of the local sociopolitical environment is essential to market development. This culturally sensitive approach is not new. All successful companies operating in the international area understand its importance at every level of decision making.

Identification of the primary market and consumers, barriers to market entry and business development, and marketing strategy are highly country specific. Even in the same country there will be marked differences regarding needs, infrastructure, language, and culture. Technology service companies, consultants, integrators, and providers must understand the specific nature of healthcare markets. Participant buy-in (government, academic, private sector providers, and telecommunication and information industry partnerships) is fundamental for success. The allocation and evaluation of costs, time, and responsibilities as well as potential litigation issues require consideration when transferring applications developed for other implementation environments. It may not be a trivial task to locate international expertise or hire appropriately skilled counterparts at the country implementation environment.

8.2.7. Partnerships as Solution to Information Systems Development and Deployment

Technical knowledge, experience, and financial investments needed to establish large and complex information system projects require tapping into resources and expertise that no organization singly retains. Public and private institutions, academic organizations, the industry, and financing agents must find ways to pool their assets through project partnerships and add social value to applications of informatics by providing new employment opportunities, socioeconomic development, educational opportunities, promoting health, and supporting cost-effective health services.

In the international setting, cooperation between developed and less developed countries is essential but special care must be taken to avoid interventionist behavior that ignores user's real needs, fails to understand host capacities, demands action without allowing sufficient time for conceptual assimilation, neglects cultural constraints, and ignores host's knowledge basis. As in many other areas of international cooperation the danger is to have too much too soon or too little too late. A possible framework for collaborative work should include support to international health issues, healthcare reform implementation, application development, education, and economic and technological cooperation.

9. Situation of Health Information Systems in Latin America and the Caribbean

Major organizational challenges regarding the deployment of health and healthcare informatics applications faced by managers, political decision-makers and developers in the Region, especially in the public sector are: poor health information infrastructure, great diversity of user needs, organizational deficiencies, access to technology, and cost.

Besides those generic barriers, there are major issues to be dealt with in the effort to spread the deployment of information systems and information technology in Latin America and the Caribbean, the most significant being:

- Disparity among Latin America and Caribbean countries regarding technological infrastructure, investment, and deployment of information systems.
- Complexity and variety of objectives, functions, and technical contents of health systems.
- Information systems must be aligned to institutional goals, and few systems are concerned with the improvement of health status and with the needs and interaction of healthcare providers, clients, payers, and regulators.
- Development of national policies and strategies on Health Informatics and understanding of how to consolidate and assess cost-effective use of modern resources related to data processing and telecommunications.
- Establishment of data-related and information communication standards.
- Access to reliable sources for healthcare application information products and services.
- Capability to purchase and maintain relatively expensive capital equipment, products and services.
- Consistency of investment and political support to ensure sustainability and continuity of information systems projects.
- Increase the number and quality of technical and educational programs and of professionals in Health Informatics.

9.1. Health Information Infrastructure

This organizational component is poorly developed in the Region. It requires clear responsibility and accountability structures, setting of objectives and targets for individuals and departments, and mechanisms for motivating people and for providing feedback about their achievements. Adequate behavioral and institutional infrastructure requires the presence of a framework that allows information to be used in a way that encourages individuals to take advantage of existing data according to their particular needs and the objectives of the organization.

Lack of organizational rationality, limited organizational skills, and inability to manage and use information for decision making constitute significant issues. Illiteracy is a barrier to the growing area of consumer-oriented health applications or "consumer informatics", the basis for individual access to health information and self-help. Unless such an appropriate framework is in place, information cannot be translated into action.

A survey of the health information infrastructure in the Region revealed major problems and constraints related to data collection, information utilization and dissemination, and to the capacitation of human resources. The survey (PAHO/WHO Health Services Information Systems Resources Survey) was conducted in 1996 by the Health Services Information Systems Program (HSP/HSI) through PAHO's Representations. The objective of the survey was to evaluate the status of development of the information function in the Region including organizational development and infrastructure. Key informers in twenty-four countries responded to the survey. An analysis of the findings is presented in the next pages.

9.1.1. Data Collection, Processing, and Information Utilization

Data capture and its accuracy represent the most serious problem in the operation of information systems and major stumbling blocks confronted by systems operators relate to the quality of data sources and the timely data collection and recording. An analysis of the degree of development of nine core information systems functions studied by the PAHO/WHO Health Services Information Systems Resources Survey showed that nearly all countries conduct systematic health data collection, recording, and archiving, based on norms and standards defined at the national level (Table 3.).

Most of the information collected refers to services provided and epidemiological surveillance. In two-thirds of the countries it was considered to be of intermediate level of detail and data organization, in about one-sixth to be of low level of detail and data organization, and in only 12 to 16% of cases considered to be advanced. Significantly, data related to users and their families, the environment, health risk factors, user satisfaction with health services and violence to women and children were not collected or sporadically collected in about two-thirds of the countries surveyed.

Table 3. Degree of Development of Nine Core Information Function Activities in Twenty-four Latin American and Caribbean Countries in 1996 Categorized by Level of Detail and Data Organization and Expressed as Percentage of Respondents

INFORMATION FUNCTION ACTIVITY	ABSENT	LOW	INTERMEDIATE	ADVANCED
Systematic data collection following national standards	4.2	20.6	62.5	12.5
Recording and Archiving	4.2	12.5	66.7	16.7
Information about services provided	0.0	20.8	62.5	16.7
Information about users and their families	29.2	50.0	20.8	0.0
Information related to epidemiological surveillance	0.0	12.5	75.0	12.5
Information about the environment	12.5	41.7	37.5	8.3
Information about health risk factors	20.8	50.0	25.0	4.2
Information about violence (women and children)	20.8	70.8	8.3	0.0
Information about user satisfaction with health services	25.0	54.2	20.8	0.0

When data are processed and information is available, its utilization by health professionals is another important problem. Of the seven areas of application studied, the level of information use was reported consistently as absent or low. Only in the area of service evaluation and support to service operation, was the level of utilization considered to be intermediate to advanced in one-third of the countries. Significantly, very little use is made of data in the areas of clinical decision making, cost of service, and clinical and administrative research (Table 4.)

Table 4. Utilization of Data and Information by Areas of Application in Twenty-four Latin American and Caribbean Countries in 1996 Categorized by Level of Utilization Expressed as Percentage of Respondents

AREA OF APPLICATION	ABSENT	LOW	INTERMEDIATE	ADVANCED
Type of service provided	16.7	62.5	16.7	4.2
Support to service operation	4.2	58.3	33.3	4.2
Clinical decision making	25.0	50.0	25.0	0.0
Evaluation of service processes	12.5	54.2	29.2	4.2
Evaluation of staff performance	33.3	41.7	25.0	0.0
Cost of services	45.8	29.2	16.7	8.3
Clinical and administrative research	37.5	50.0	12.5	0.0

Countries are confronted with continuing constraints in their infrastructure for the generation, analysis, summarization, reporting, communication, and especially in using health data and information for the better management of their health programs and services. In summary, the following problems and constraints characterize most of the information systems in the Region:

- Requirements for data recording and reporting by service staff are excessive in that much of the required data are not used in the tasks they perform in case and facility management, with the result that there is an unnecessary recording and reporting burden on service staff. Such extensive reporting also leads to great amounts of data accumulating at all levels of the system, little of which are analyzed and used.
- Lack of awareness by health policy-makers and program managers of the strategic importance and practical usefulness of health information for planning and management results in low demand for information.
- Data routinely reported by health services are considered of dubious quality in terms of validity and completeness, and therefore are frequently not relied upon.
- Data on the health of those without access to services, or who use private sector services, are missing from government-run health information systems.
- There is increasing use of general and special-purpose surveys, often supported by international agencies, to capture data, some of which should be available within routine reporting systems. Such surveys further lessen reliance on the routine data.
- In many countries, disease surveillance systems do not function adequately.
- Data capture at the point of care and data entry or recording in manual or automated databases represent two significant problem areas in health data management.
- Despite considerable investment in computers and data processing, inadequate use is being made of available technological options for the better management and communications of health data.
- Various departments, programs, and institutions within the health sector tend to develop their own data collection systems. Effective coordination of health information is often lacking, which results in duplication and gaps in data collection, reporting, use, and management.
- Analysis, reporting and feed-back of health data and information from the central level to the services is rare and not well prepared, and reports to international agencies are inconsistent and dominated the indicators promoted by the agencies, which may not be relevant for national use.
- The greatest need remains the establishment of information systems that enable the recovery of patient-oriented, problem-oriented, and procedure-oriented data to assist in the assessment of the impact of health services on the health status of individuals and populations.

9.1.2. Health Information Dissemination by the Public Sector

Most of public health data dissemination is done through printed media and programmed meetings, although electronic networking is reported to be in use at intermediate or advanced level by one-third of the countries. Lack of utilization of the Internet as a mean to disseminate health information was reported by one-third of the countries, another third reporting low level of use of this ubiquitous resource (Table 5.).

Table 5. Degree of Development of Mechanisms Used for Information Dissemination in Twenty-four Latin American and Caribbean Countries in 1996 Categorized by Level of Deployment Expressed as Percentage of Respondents

MECHANISM	ABSENT	LOW	INTERMEDIATE	ADVANCED
Newsletter/Bulletin	12.5	29.2	50.0	8.3
Programmed meetings	8.3	37.5	37.5	16.7
Electronic networking	20.8	37.5	29.2	12.5
Access to the Internet	37.5	33.3	16.7	12.5
Other form	25.0	25.0	37.5	12.5

9.1.3. Education and Training of Human Resources in Health Informatics

Nearly one-third of the countries do not have training programs in health information systems for mid-level and higher management. When programs do exist, in half of the countries they are considered inadequate (Table 6.). In about two-thirds of the countries training is conducted at the local, regional, and national levels. Very few countries participate in international training schemes

Table 6. Degree of Development of User Training in the Generation and Utilization of Information in Twenty-four Latin American and Caribbean Countries in 1996 Categorized by Level of Training Expressed as Percentage of Respondents

TRAINING LEVEL	ABSENT	LOW	INTERMEDIATE	ADVANCED
Operative Level	13.0	52.2	30.4	4.3
Mid-Level Administration	26.1	43.5	26.1	4.3
Higher Management	26.1	43.5	21.7	8.7

9.1.4. Hospital Information Systems

The hospital subsector is the area better served by information systems. Of the 16,566 hospitals registered in PAHO's Directory of Latin American and Caribbean Hospitals database, 6,267 (37.83%) indicated that they had formal information systems in place. Of these, a total of 5,230 hospitals (83.45%) reported using computers (or 31.57% of the 16,566 hospitals).

In Table 7 are presented details of the legal ownership of hospital institutions. Considering all facilities, public hospitals, including those belonging to the social security, account for 44.51%; private total 46.98%; philanthropic total 7.75%; and military the remaining 0.75%. There are, however, significant differences in the existence of information systems among institutions according to ownership. Of hospitals reporting to have information systems, in terms of absolute numbers, nearly 60% are private and little less than one-third are public (32.1%).

The relative distribution of information systems and computer utilization provides a different picture. Although the social security hospital facilities constitute only 5.29% of all establishments, they proportionally (Table 8.) have the higher number of information systems, 467 out of 876 (53.31%), followed by private (47.67%), philanthropic (40.03%), military (24%), and public non-social security (23.79%). It is noteworthy that above 93% of the social security hospitals with information systems are computerized. The disparity between the existence of information systems in the two types of public hospitals, public social security and public non-social security is evident, even though the relative percentage of computer utilization is not that great (see Table 8.).

Table 7. Legal Ownership of 16,566 Hospitals and of 6,267 Hospitals with Formal Information Systems in Latin America and the Caribbean, period 1995-1997 (Percent Values Refer to the Total Number of Facilities in each Group)

GROUP	NO INFO SYST		WITH INFO SYST		WITH COMPUTERS		ALL FACILITIES	
OWNERSHIP	Number	Percent	Number	Percent	Total	Percent	Number	Percent
Public Non-Social Security	4,952	48.08	1,546	24.67	1,399	26.74	6,498	39.22
Public Social Security	409	3.97	467	7.45	438	8.37	876	5.29
Private	4,073	39.55	3,710	59.20	2,859	54.66	7,783	46.98
Philanthropic	770	7.47	514	8.20	505	9.65	1,284	7.75
Military	95	0.92	30	0.47	29	0.55	125	0.75
Total	10,229	100.0	6,267	100.0	5,230	100.0	16,566	100.0

Only about 40% of philanthropic hospitals have information systems but, considered as a group, computer utilization is highest (98.24%) by this category, followed by military (96.66%) and public hospitals (91.25%). Private hospitals reporting having information systems, on the other hand, have the lowest utilization of computers (77.06%).

Table 8. Hospitals with Information Systems by Ownership Category

OWNWESHIP	HOSPITALS	INFO SYST	PROPORTION	COMPUTERS	% COMPUTERS
Public Non-Social Security	6,498	1,546	23.79	1,399	90.49
Public Social Security	876	467	53.31	438	93.79
Private	7,783	3,710	47.67	2,859	77.06
Philanthropic	1,284	514	40.03	505	98.24
Military	125	30	24.00	29	96.66

Of all Latin American and Caribbean hospitals, 10,027 (60.53%) have 50 or fewer beds and of those, 5,621 (56%) are private, 3,806 (37.95%) are public, 529 (5.27%) are philanthropic, and 71 (0.7%) are military. Smaller hospitals have fewer information systems but it is noteworthy that, except for philanthropic and military hospitals, a small size (50 or less beds) does not appear to significantly alter the relative proportion of hospitals with systems (Table 9).

Table 9. Hospitals with 1-50 Beds and Information Systems by Ownership Category

OWNERSHIP	HOSPITALS	1-50 BEDS	PROPORTION	INFO SYST	% INFO SYST
Public Non-Social Security	6,498	3,382	52.04	603	17.82
Public Social Security	876	424	48.40	199	46.93
Private	7,783	5,621	72.22	2,325	41.36
Philanthropic	1,284	529	41.19	120	22.68
Military	125	71	56.80	5	7.04

Table 10 presents the distribution of hospitals with and without information systems categorized by grouping countries considering the percentage of institutions with information systems. Group 3, which includes countries with information systems in 31% to 50% of their hospitals, comprises the largest number of instances, 5,447 institutions which represent 39.96% of 13,630 hospitals (82.27% of the total number of hospitals in the database). The representative countries in this group, ordered by number of implemented institutions, include: Brazil, Mexico, Argentina, Colombia, Chile and Paraguay. Only 439 institutions (7% of the hospitals with information systems) comprise Groups 1 and 2 (countries with information systems in above 51% of their facilities). Most information systems are automated; of the 6,267 institutions with information systems, 5,230 (83.45%) have computers. There are, however, no details available regarding type and level of implemented applications.

It is interesting to note that there is no association of clinical residency programs and the existence of information systems -- of the total universe of 16,566 hospitals, 5,764 (34.79%) have clinical residency, while of the 6,267 hospitals with information systems, only 1,735 (27.68%) indicated having residency programs

Table 10. Information Systems in 16,566 Hospitals of Latin America and the Caribbean Grouped by Percentage of Hospitals with Systems Implemented and in Operation

GROUP	COUNTRY	TOTAL NUMBER HOSPITALS	% TOTAL No. HOSP	WITHOUT INFO SYS	WITH INFO SYSTEM NUMBER HOSPITALS	WITH INFO SYSTEM % WITH IS	WITH COMPUTER NUMBER HOSPITALS	WITH COMPUTER % WITH COMPUTER
Group 1 - Above 71%	TURKS & CAICOS	1	0.006	0	1	100.00	1	100.00
	BAHAMAS	5	0.030	1	4	80.00	4	80.00
	PUERTO RICO	90	0.543	20	70	77.78	64	71.11
	Subtotal Group 1	96	0.580	21	75	78.13	69	71.88
Group 2 - Between 51-70%	GUADELOUPE	10	0.060	4	6	60.00	6	60.00
	URUGUAY	111	0.670	45	66	59.46	66	59.46
	PERU	443	2.674	180	263	59.37	262	59.14
	COSTA RICA	33	0.199	14	19	57.58	19	57.58
	NETH ANTILLES	11	0.066	5	6	54.55	6	54.55
	BERMUDA	2	0.012	1	1	50.00	1	50.00
	MARTINIQUE	6	0.036	3	3	50.00	3	50.00
	Subtotal Group 2	616	3.718	252	364	59.09	363	58.93
Group 3 - Between 31-50%	PARAGUAY	236	1.425	121	115	48.73	57	24.15
	MEXICO	3033	18.309	1603	1430	47.15	693	22.85
	COLOMBIA	1053	6.356	618	435	41.31	417	39.60
	BRAZIL	6124	36.967	3786	2338	38.18	2313	37.77
	CHILE	385	2.324	241	144	37.40	144	37.40
	ARGENTINA	2780	16.781	1801	979	35.22	812	29.21
	ST LUCIA	6	0.036	4	2	33.33	2	33.33
	SURINAME	13	0.078	9	4	30.77	4	30.77
	Subtotal Group 3	13630	82.277	8183	5447	39.96	4442	32.59
Group 4 - Between 11-30%	EL SALVADOR	77	0.465	54	23	29.87	23	29.87
	HONDURAS	89	0.537	66	23	25.84	23	25.84
	PANAMA	55	0.332	41	14	25.45	13	23.64
	GUATEMALA	145	0.875	109	36	24.83	36	24.83
	VENEZUELA	348	2.101	271	77	22.13	54	15.52
	US VIRGIN ISLANDS	23	0.139	18	5	21.74	5	21.74
	ECUADOR	299	1.805	240	59	19.73	59	19.73
	NICARAGUA	78	0.471	66	12	15.38	12	15.38
	CUBA	243	1.467	206	37	15.23	37	15.23
	BOLIVIA	385	2.324	327	58	15.06	58	15.06
	DOMINICAN REPUBLIC	213	1.286	183	30	14.08	30	14.08
	BARBADOS	8	0.048	7	1	12.50	1	12.50
	Subtotal Group 4	1963	11.850	1588	375	19.10	351	17.88
Group 5 - Less than 10%	BELIZE	10	0.060	9	1	10.00	1	10.00
	HAITI	103	0.622	99	4	3.88	3	2.91
	TRINIDAD & TOBAGO	64	0.386	63	1	1.56	1	1.56
	Subtotal Group 5	177	1.068	171	6	3.39	5	2.82
Group 6 - None	ANGUILLA	2	0.012	2	0	0.00	0	0.00
	ANTIGUA & BARBUDA	3	0.018	3	0	0.00	0	0.00
	BRITISH VIRGIN ISLANDS	2	0.012	2	0	0.00	0	0.00
	DOMINICA	1	0.006	1	0	0.00	0	0.00
	GRENADA	5	0.030	5	0	0.00	0	0.00
	GUYANA	35	0.211	35	0	0.00	0	0.00
	JAMAICA	31	0.187	31	0	0.00	0	0.00
	MONTSERRAT	1	0.006	1	0	0.00	0	0.00
	ST KITTS & NEVIS	3	0.018	3	0	0.00	0	0.00
	ST VINCENT & GRENADINES	1	0.006	1	0	0.00	0	0.00
	Subtotal Group 6	84	0.507	84	0	0	0	0.00
	TOTAL	16566		10299	6267	37.83	5230	31.57

Source: Directory of Latin American and Caribbean Hospitals, 1996-1997 (Div Health Systems and Services Development)

9.2. Information Technological Infrastructure

Investment in information systems and information technology must be linked to the right strategy to achieve long-term benefits. Greater value and longer life cycles of application products can be achieved in information systems projects when effort is directed to technology-independent development of common information functions, data standards, and data manipulation methods established across all applications.

9.2.1. Systems Specification Issues

A major problem in systems specification refers to persistent ambiguity in objectives and functions wanted - health sector applications may reflect the chronic problems of the sector: lack of agreement on priorities, lack of a coordinated approach to problem solving, poor definition of contents of care, and of minimum data sets to support decision-making. Failing to resolve ambiguity in application development represents a serious risk and may surface as organizational conflicts, low usability, and inappropriateness. A shared mission statement, robust requirements process, peer reviews of critical specifications, and user involvement in the design process will go a long way to prevent future problems. Given today's rapid and often unpredictable changes in the economics of health, in the organization and strategies of health services, the growing competitiveness among healthcare providers, and the changing of information requirements, health organizations must realistically expect that their information systems will be changing accordingly.

Appropriate systems specification process addresses the logical requirements of systems and avoid the temptation of technology-driven or imposed development solutions. The objective is to detach issues related to the physical implementation of an informatics solution, with its questions of software and hardware platform options, functional access, and actual application development, from the more permanent logical "knowledge" assets, represented by information structures standardized at a higher level of the systems architecture. The aim of the model is to differentiate between long-term knowledge assets and implementation environment associated short-term technological assets, and particularly, procedures, hardware and code-related issues. This approach will facilitate autonomy regarding physical systems development, implementation and adaptation to user needs. The idea, therefore, is to be able to carry the knowledge-sharing assets of systems specification across different generations of systems without suffering from losses due to technology-induced innovations, as for example, the introduction of a new database management platform or operating system, and to avoid being caught into a short-term reactive behavior, dictated by the technological option *"du jour"*.

9.2.2. Promoting the Use of Common Specification Standards

When designing health applications the aim should be to promote the utilization of an agreed common set of functional and data content specification standards defined for the whole health sector at a national or even international level, as has been the case in the European Union. It involves the definition of the characteristics of systems application modules, functionalities

desired, and the selection of core data elements in the context of an integrated, scalable and platform-independent logical solution. Appropriateness of the technology, cultural and language issues, models of healthcare institutional organization and delivery, acceptance, and systems cost-benefit are major concerns of developers and users. They all play a fundamental part in the selection, form of implementation and operation of informatics applications.

Use of common specification standards will enable health application developers to draw on a pool of common knowledge and avoid redundant or repetitive developments. Such specifications will help the exchange of data across different providers, financing agents, and governmental agencies. They will further assist systems professionals to focus on any particular area of application using a general framework that will ensure consistency across different applications -- this is especially valuable for the drive toward corporate approaches to management and integration of information systems and longer application life cycles. By providing consistent specifications for all application areas, common systems standards also will leave developers and users free to concentrate on the issues that are particular to each implementation environment, such as local priorities and organizational structures.

9.2.3. Access to Information Technology

A significant issue in Latin America and the Caribbean continues to be access to technology and the availability, level, quality, and cost of telecommunication services. The technology infrastructure is generally poor compared to other regions. The human and organizational resources and capabilities and the level of technological development of providers and consumers vary widely among different countries. In most places only few computers or old generation equipment are available to direct patient care users, and generally most health professionals lack basic computer knowledge.

Frequently, there is an obsolete telecommunications infrastructure with low coverage as well as poor quality of communication lines. Although monopolies are gradually disappearing, or being significantly reduced, many countries still have a monopolistic telecommunications market with regulations and tariff structures that inhibit the utilization of the type of services that are required by health and healthcare telecommunications applications. Only in a small number of countries and, even in those, in only limited geographical areas is the telecommunications infrastructure capable of supporting cost-effective broadband applications. In most healthcare sites only a few computers or old generation equipment is available to direct patient care professionals and, throughout the health sector, there is poor knowledge of the potentialities of the computer. Most health information implementations found in the health sector in Latin America and the Caribbean correspond to applications directed towards the automation of the "back-office" and a limited number of "front-office" functions.

The information infrastructure of Latin America and the Caribbean is poorly developed and ranks just above that of Africa and some Eastern European countries, but although information technology expenditures in Latin America and the Caribbean represent only about 5% of the world total (Fig. 4), the growth of information technology in the region has been consistently the world's highest since 1985 (Fig. 5).

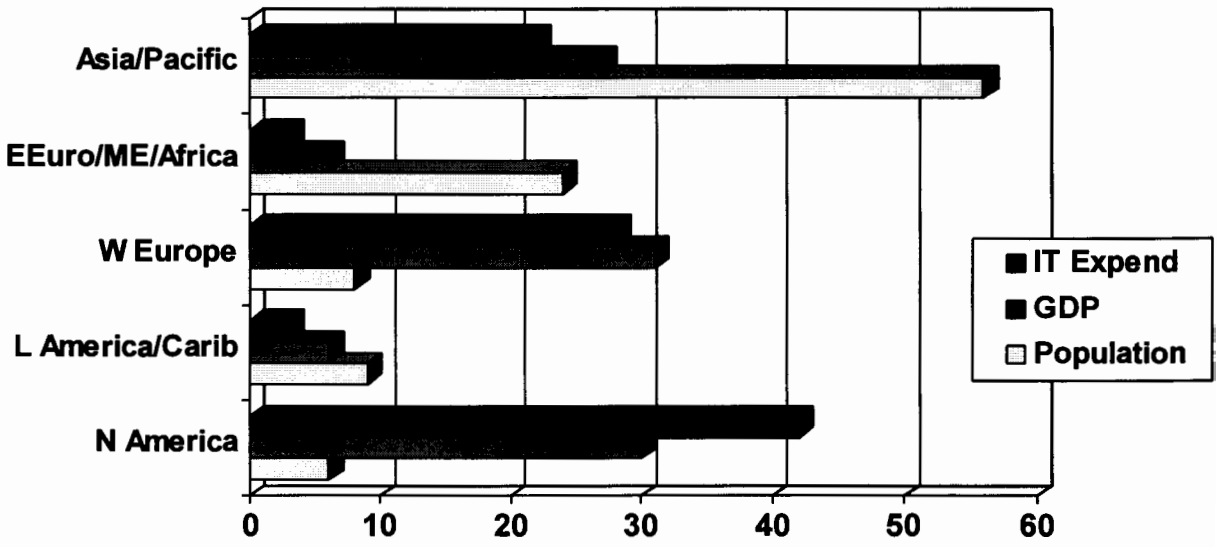


Fig. 4- Information Technology Expenditures, Gross Domestic Product and Population as Percentage for Five World Regions

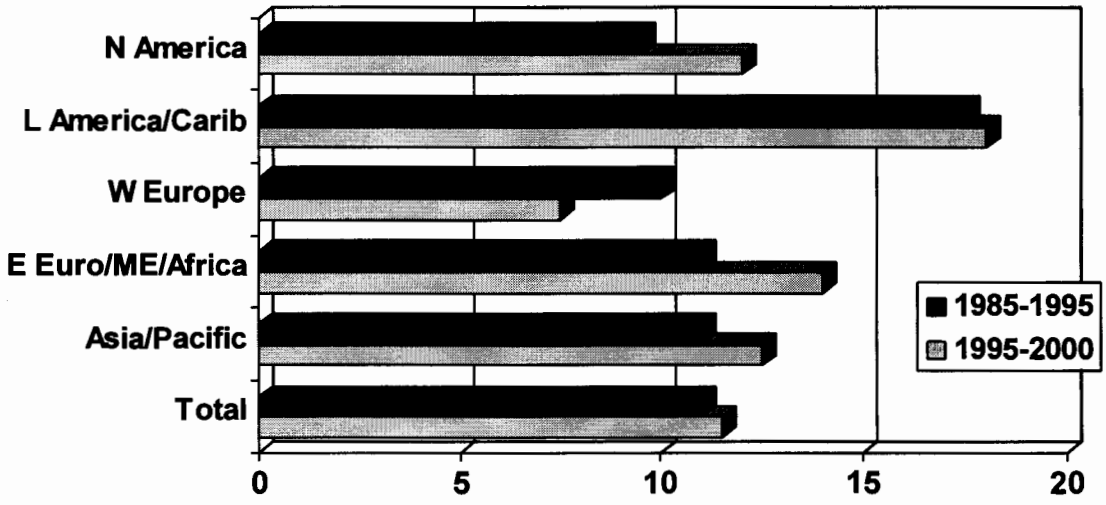
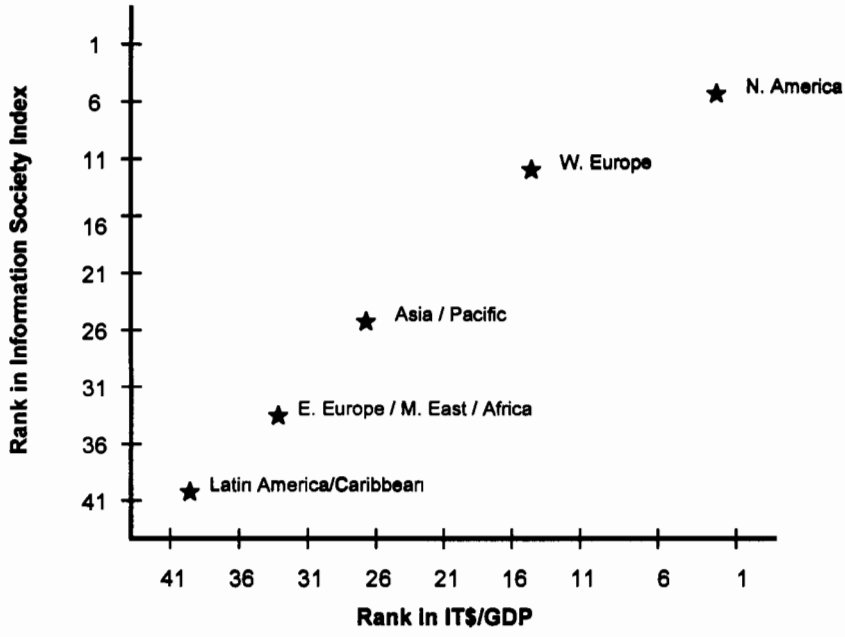
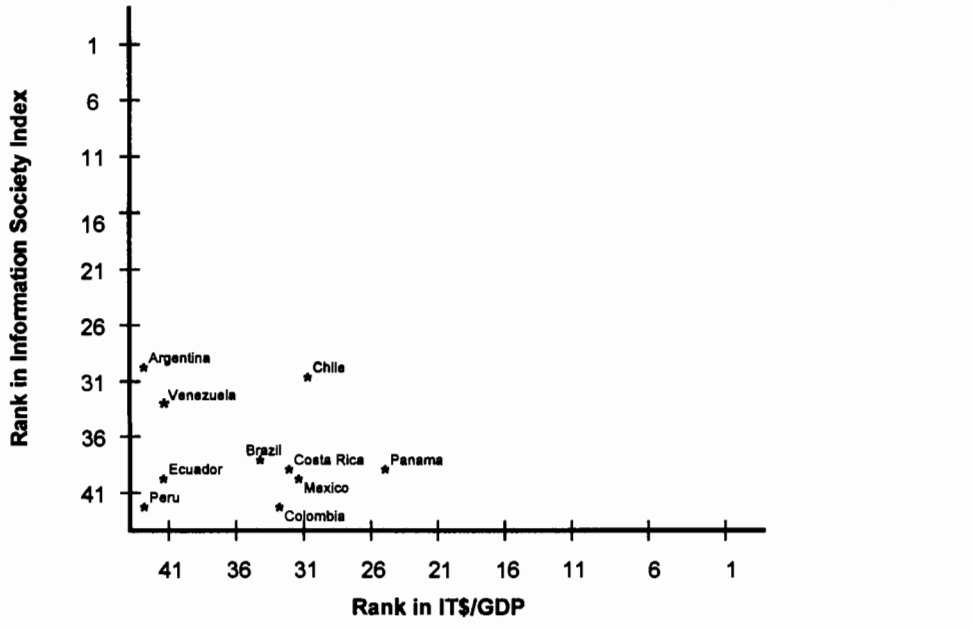


Fig. 5 - Information Technology Growth 1985-1995 and 1995-2000 (projected) (source: International Data Corporation, 1996)

Fig. 6 shows the ranking of five regions (North America, Latin America and the Caribbean, Western Europe, Eastern Europe/Middle East/Africa, and Asia/Pacific) regarding the Information Society Index (ISI), that considers the information infrastructure as developed by World Times, Inc. and the International Data Corporation, and the Expenditures in Information Technology as percentage of the Gross Domestic Product (IT$/GDP).



SOURCE: International Data Corporation, 1996



SOURCE: International Data Corporation, 1996

Fig. 6 - Information Society Index and IT Expenditure/GDP Ranking for World Regions (upper) and Selected Latin American Countries (lower)

Table 11. Geographic Internet Domain Hosts, Telephone Lines and Television and Radio Receivers in Selected Latin American and Caribbean Countries Ranked by Population/Host Index

COUNTRIES	POPULATION x 1,000	REGISTERED HOSTS	% TOTAL	POPULATION PER HOST	TELEPHONES PER 100 PERS	TV RECEIVERS PER 1,000 PERS	RADIO RECEIVERS PER 1,000 PERS
ANTIGUA	66	169	0.103	391	28.9	356	417
CHILE	14,641	15,885	9.683	922	11.0	210	344
COSTA RICA	3,575	3,491	2.128	1,024	11.1	141	258
DOMINICA	71	55	0.034	1,291	19.1	72	587
BAHAMAS	284	195	0.119	1,456	30.3	225	592
URUGUAY	3,221	1,823	1.111	1,767	16.8	166	232
BRAZIL	167,046	77,148	47.027	2,165	7.5	208	386
ARGENTINA	35,405	12,688	7.734	2,790	12.3	221	683
MEXICO	97,245	29,840	18.189	3,259	8.8	149	255
DOMINICAN REPUBLIC	8,098	2,301	1.403	3,519	7.4	87	171
PANAMA	2,722	751	0.458	3,625	10.2	167	224
COLOMBIA	36,200	9,054	5.519	3,998	11.3	117	177
PERU	24,691	5,192	3.165	4,756	2.9	98	254
ST LUCIA	146	21	0.013	6,952	15.4	190	759
NICARAGUA	4,731	531	0.324	8,910	1.7	66	262
VENEZUELA	22,777	2,417	1.473	9,424	9.9	163	448
TRINIDAD & TOBAGO	1,335	141	0.086	9,468	15.0	316	494
JAMAICA	2,483	249	0.152	9,972	10.6	134	421
BARBADOS	264	21	0.013	12,571	31.8	280	876
HONDURAS	5,981	408	0.249	14,659	2.1	73	387
GUYANA	854	52	0.032	16,423	5.1	40	493
BOLIVIA	7,774	430	0.262	18,079	3.0	103	613
ECUADOR	11,937	590	0.360	20,232	5.3	85	318
ST KITTS & NEVIS	41	2	0.001	20,500	29.6	206	648
PARAGUAY	5,220	187	0.114	27,914	3.1	52	66
GUATEMALA	11,241	274	0.167	41,026	2.3	82	171
EL SALVADOR	6,027	132	0.080	45,659	3.2	93	413
SURINAME	432	4	0.002	108,000	11.6	132	639
	474,508	164,051	100	2,892 (a)	11.69 (a)	151.14 (a)	413.86 (a)

- Internet Hosts represents the number of hosts registered under geographic domains and does not include hosts registered in organizational domains (.com, .org, .net, etc.). Data for January 1997.
- Data for telephone lines are for 1993
- Data for television and radio receivers are for 1992

(a) Average values

Sources: Organization of American States RedHUCyT Project
United Nations 1995 Statistical Yearbook (40th Edition)

Many Ministries have embarked on the computerization of their services aiming at providing better information for management and service delivery. Most of the initiatives have been centralized in health information units, but there is a growing tendency towards decentralization; however, rarely have systems been implemented at the level of primary or community care centers. These systems have had a positive result on the timeliness and accuracy in retrieving data and information about service utilization, patient flow, resource utilization, disease surveillance, morbidity and mortality patterns, and in the operation of healthcare and ancillary services. In the Eastern Caribbean a major project funded by the Inter-American Development Bank was initiated in 1995 with the objective of deploying community health services information systems, but its impact is still to be evaluated.

Countries with on-going information systems projects of significance which consider a broader scope of information utilization include: Argentina, Chile, Uruguay, Brazil, Bolivia, Venezuela, Colombia, Barbados, Belize, Grenada, St. Vincent and the Grenadines, St. Lucia, Dominica, Jamaica, Cuba, Panama, Guatemala, Costa Rica and Mexico. In Costa Rica and Mexico important telecommunications-based projects have been recently initiated.

In the past three years there has been a brisk growth of the Internet connectivity in Latin America and the Caribbean, as measured by the number of hosts (164,051 by January 1997) registered under the corresponding geographic domain (Figs 7, 8, 9, 10, 11). Although the numbers do not reflect the real total number of hosts in each country, because organizational domain hosts were not included in the above figure, they demonstrate the growing number of hosts in every country.

An analysis of the distribution of Internet hosts exhibits wide variation, which becomes more evident when one considers the corresponding country population -- the number of inhabitants per host being a good indicator of the penetration of Internet-related technologies in the Latin American and Caribbean region (Table 11). The number of telephone lines per 100 inhabitants is still low (average 11.69 lines per 100 persons) when, for example, compared to the U.S. (57.4 per 100 persons) or Canada (59.2 per 100 persons). The same is valid for television and radio receivers per 1,000 inhabitants. Increased connectivity and access to the Internet will require major expansion of the telecommunications infrastructure in nearly all countries.

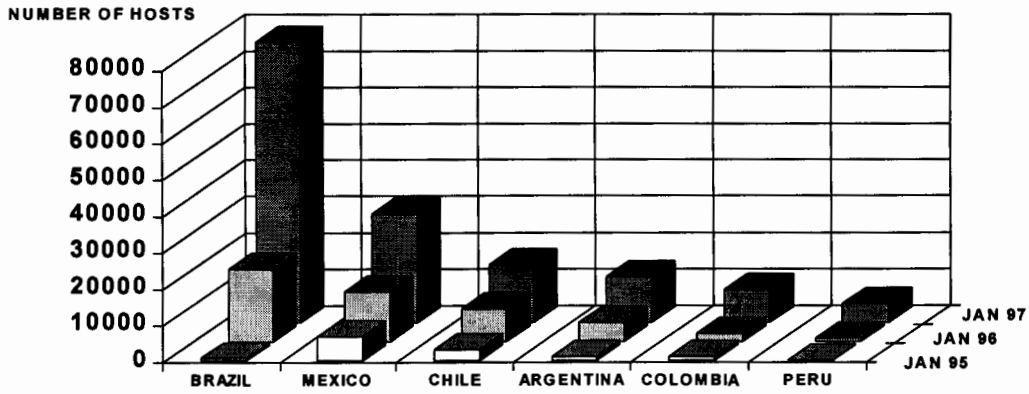


Fig. 7 - Growth of Internet Hosts in Selected Countries, Period 1995-1997
(source: Organization of American States, Project RedHUCyT)

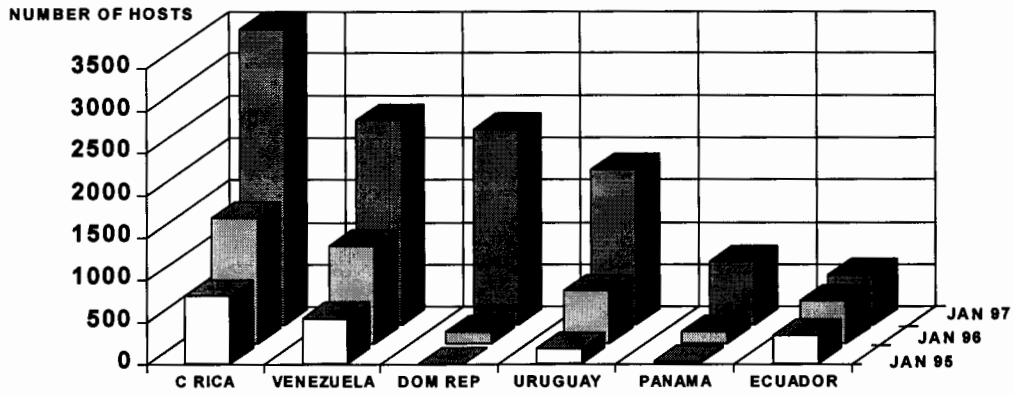


Fig. 8 - Growth of Internet Hosts in Selected Countries, Period 1995-1997
(source: Organization of American States, Project RedHUCyT)

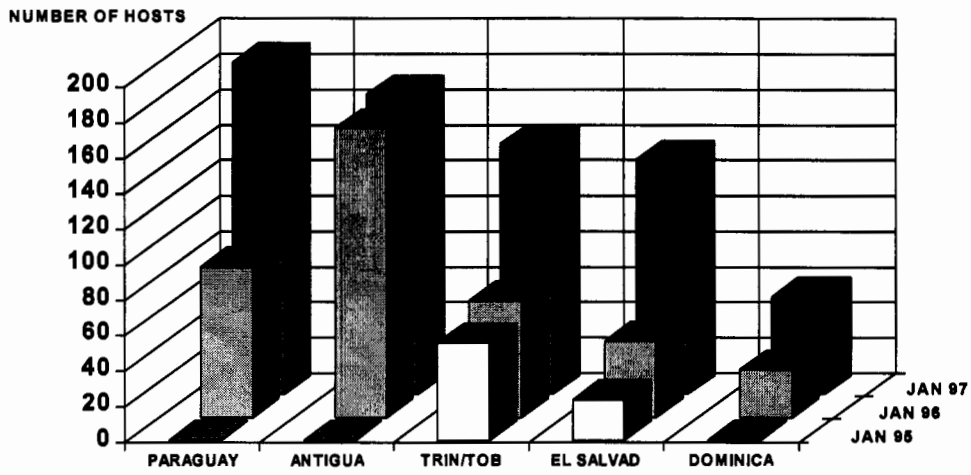


Fig. 9 - Growth of Internet Hosts in Selected Countries, Period 1995-1997
(source: Organization of American States, Project RedHUCyT)

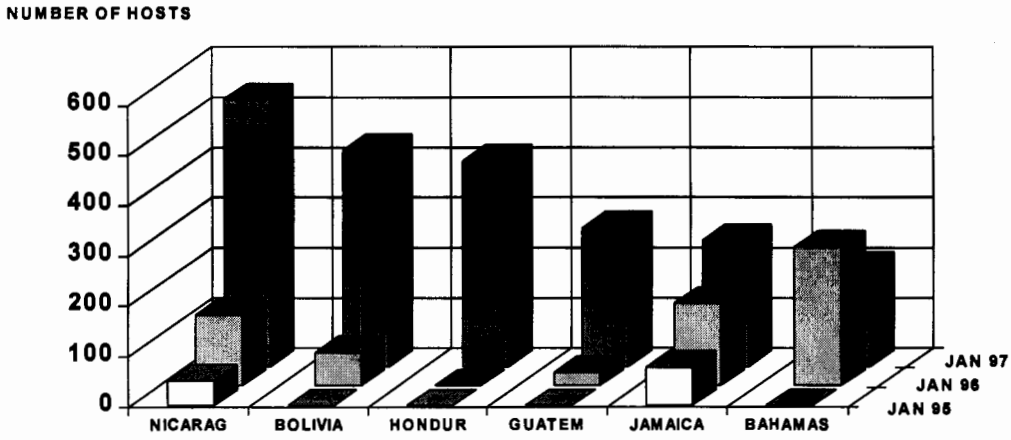


Fig. 10 - Growth of Internet Hosts in Selected Countries, Period 1995-1997
(source: Organization of American States, Project RedHUCyT)

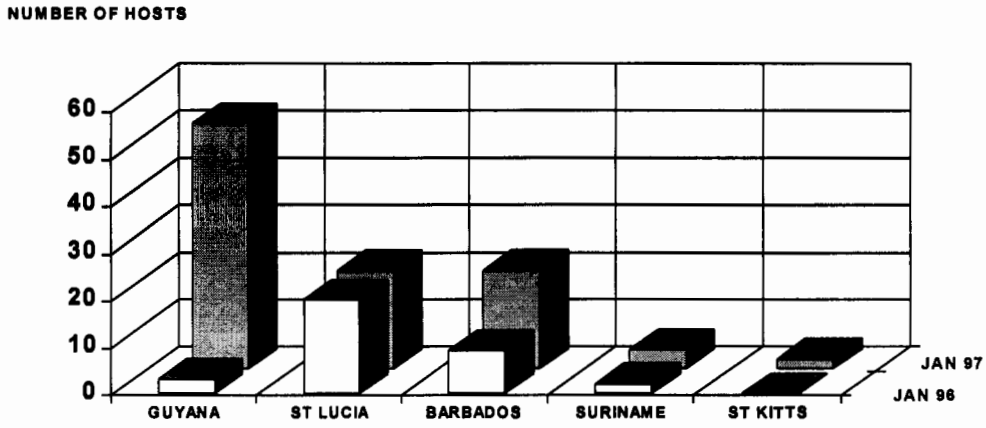


Fig. 11 - Growth of Internet Hosts in Selected Countries, Period 1995-1997
(source: Organization of American States, Project RedHUCyT)

9.2.4. Implementation Issues

A review of the experience shows that there is a broad spectrum of possible applications that can take advantage of current technology and there are many options for each application area. The selection of a technological option depends on existing infrastructure and local requirements. Chief concern regarding the development and implementation of health information systems applications is the search for appropriate solutions to infrastructure problems, user interfaces, and health-specific products. Another significant issue in most developing countries, besides access to technology, relates to the availability, level, quality, and cost of technical staff support and technical services.

Technology assessment is too important to be left to technologists, medical specialists and service providers alone, as they have a tendency to focus exclusively on innovations with narrow applications. Appropriateness of the technology, cultural and language issues, models of healthcare institutional organization and delivery, acceptance, and cost-benefit of systems are major concerns of developers and users. They all play a fundamental part in the selection, form of implementation and operation of informatics and telecommunications applications. Notwithstanding the fact that the lack of information systems has been shown to be one reason for inequalities of access and care quality among individuals and society groups, the inappropriate implementation of applications may indeed widen the gulf between the haves and the have-nots.

9.2.5. Sustainability of Initiatives

A retrospective of project experiences shows that continuity and sustainability of information systems projects continue to be a major problem in the Region. A common observation is that externally funded projects frequently collapse upon funding termination and this fact demonstrates that all projects need justification in terms of cost-benefit and long-term financial sustainability besides organizational capacity to develop and implement information systems. This further indicates that spreading the financial risk across several stakeholders may be appropriate as cost sharing increases overall awareness, utilization, and long term potential for success.

10. Health Systems / Health Informatics Relationships and the Application Market

A discussion on the macro-level relationships between the technological, economic, and institutional features of the healthcare implementation environment and Informatics technological options is essential for the understanding and development of market scenarios for Health Informatics applications.

The organizational designs of healthcare systems in the past 75 years were characterized by a trend towards large scale, standardization, and by technology intensiveness and a move in the direction of centrally controlled operations. All such large-scale healthcare industry organizations can be categorized in one of the following patterns of ownership/payment for services model:

- Social Welfare Model - single payer, central policy and administration large-scale government model which, in some cases, owns medical practices and hospitals. There may be a mandatory insurance supplemented by public funds (Bismarck Model) or universal state-funded healthcare (Beveridge Model).

- Market-driven Model - national for-profit or non-profit corporate ownership of facilities and providers and transition from a service industry to a business system where healthcare is a commodity that can be sold to consumers.

- Mixed Models - that combine, in different degrees, characteristics of both systems in grades or types of care available to defined categories or " tiers" of beneficiaries. Mix of public and private providers.

In the recent past there has been growing discussion on what has been called a Devolved Model of healthcare organization. Dissatisfaction with the inertia, standardization, and lack of the "human face" of large organizations and the fact that local fit and customer-oriented products are difficult to achieve in large centralized systems were the major determinants for this model of healthcare organization. This model conceives a "bottom-up" community-led and collaborative healthcare structure characterized by shift from an emphasis on established professional medical care, institutional, and episode-related acute care to one that focus on preventive interventions, health promotion, ambulatory care, and self-management of health problems.

To understand how the healthcare information technology market is likely to evolve in the variety of evolving healthcare systems environments in Latin America and the Caribbean, one must consider the relations among the three components of sociotechnical systems (people, organization, and technology) and proceed to build macro-level scenarios that address the institutional features of each health system organizational model.

Traditional management dedicated much importance to the role of people and technology in their relation with organizations. With the extensive deployment of mission critical technology applications in the support of management, production and operations, issues related to the interaction between people and technology came to the forefront. It became clear that most of the

implementation and operation problems found in the application of informatics were not of technical nature but related to human factors, the "third side" (Fig. 12).

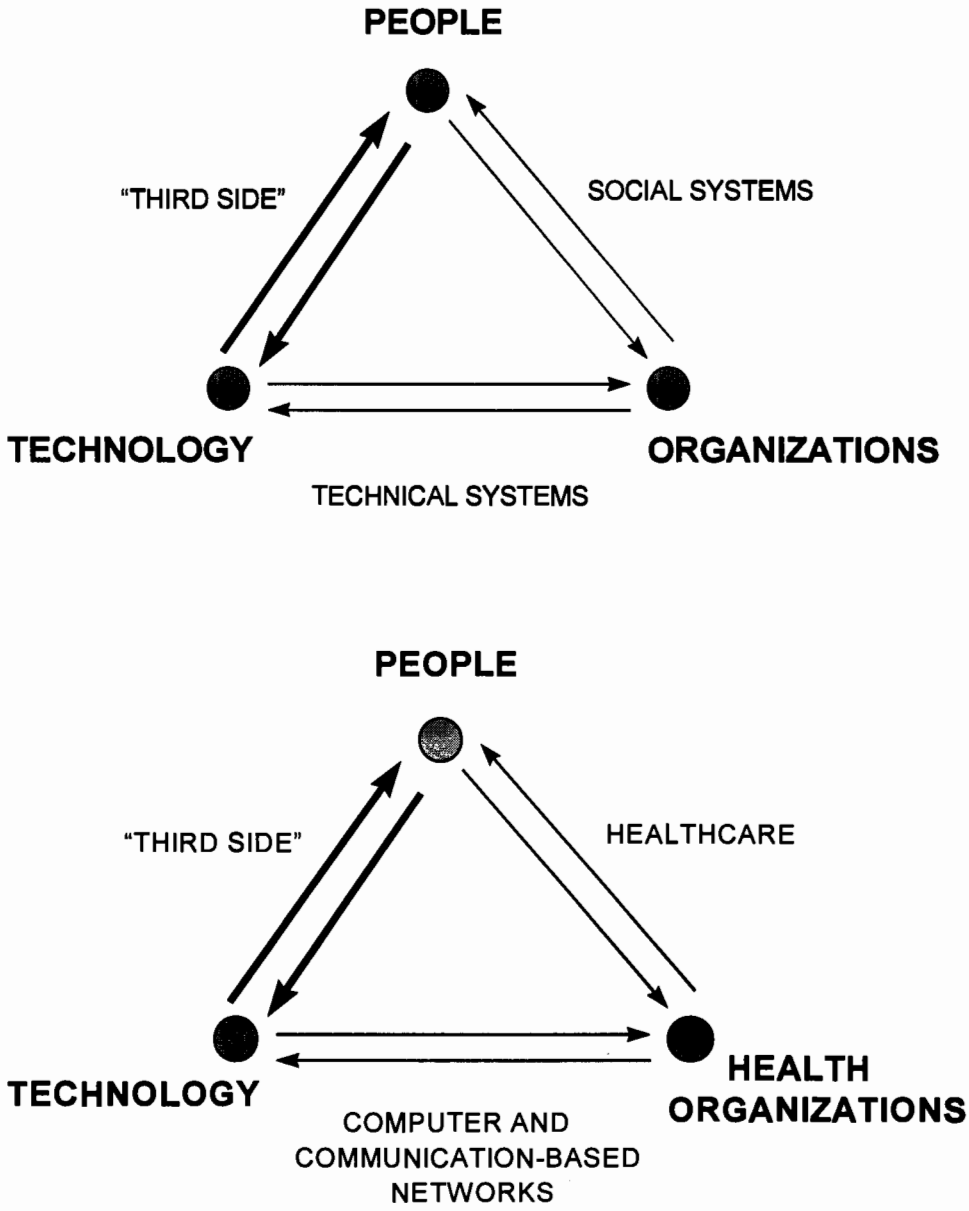


Fig. 12 - Sociotechnical Systems

Inside each country, for each specific application environment one must carefully consider the particular characteristics of the people-technology complex, the institutional features of health organizations, and the available technology for market development and applications deployment.

10.1. Application Environments

A comprehensive classification of healthcare information technology services, as proposed by the TELMED Project of the European Commission, Directorate General XIII, and slightly modified include:

- Electronic Data Interchange (EDI) - generic infrastructure services designed to handle connectivity and electronic messaging and transactions, which constitute a basic pre-requisite for health informatics deployment.

- Health Facilities Information Systems - includes hospital, clinic, physician office, and diagnostic and therapeutic support services information systems for intra or inter-site storage, processing, retrieval, and dissemination of clinical and administrative data and information.

- Medical Imaging - the storage, processing, retrieval, and communication of medical images.

- Electronic Patient Record (EPR) - integrate and provide multisite concurrent access to sets of clinical and administrative patient data in a distributed database, including different support media such as smart-card technology.

- Decision Support Systems - or expert systems which facilitate clinical and managerial decision making by interactive dialogue between a provider and a patient with a knowledge database through a rule-driven application. Systems of this type include clinical diagnostic systems, stand-alone monitoring applications, facility and equipment management applications, bibliographic and reference retrieval, and some advanced types of community health call centers.

- Community Health Services - includes the provision of integrated services to monitor community health, including health status indicators, epidemiological surveillance, environmental health, consumer education, health promotion, public information, self-care applications, and community health call centers.

- Telemedicine - including diagnostic teleconferencing, transmission of high-resolution images and biological signals for off-site diagnosis, and robotic telesurgery.

- Distance Education - or teleducation and teletraining of health professionals.

10.2. Evaluation of Health Informatics

There are major challenges in evaluating clinical and administrative applications of Health Informatics. They are a consequence of the rapid technological advancement, the complexity and variety of the technical infrastructure, and the unusual level of cooperation that healthcare demands from a variety or more or less independent institutions and individuals.

The development of an evaluation framework should start with the perspective of the evaluative process - is the evaluation only going to look at the past (retrospective evaluation) or is it going to adopt a prospective or interim evaluation methodology that will create the opportunity for mid-course changes? Ideally, better evaluation is dependent on careful attention to the following guidelines:

- should be treated as an integral part of program design, implementation, and operation,
- should be seen as a cumulative and forward-looking process for building useful knowledge for decision makers rather than an isolated research exercise,
- should be designed to compare costs, impacts, and benefits with those of current practice, and
- should focus on the identification of practical and economical ways to achieve desired results rather than investigating the most exciting or advanced technological options.

A number of approaches have been used, and the most significant tasks to accomplish lie not so much in evaluating particular pieces of equipment as in evaluating applications and processes of care that combine complex technologies, people, and organizational systems in varied ways to fit different institutions, environments, and objectives. Evaluation efforts and corresponding frameworks have been constructed by a number of government and private organizations. In Europe, a large number of evaluative studies have been conducted, most of them supported by the European Commission Directorate General XIII, others by national health authorities, such as the United Kingdom National Health Service. In the United States, evaluation studies have been conducted by the National Library of Medicine, the Health Care Financing Administration, the Agency for Health Care Policy and Research, the Department of Health and Human Services Office of Rural Health Policy, the Department of Defense, the National Telecommunications and Information Administration, the Department of Commerce, and the Department of Veterans Affairs. International organizations, such as the World Health Organization and the International Telecommunications Union, have also produced important evaluation studies.

The literature concerning the development and evaluation of healthcare information systems shows a striking conformity. The overwhelming majority of studies start from the assumption that information technology maximizes organizational and client's benefits, access, and quality of care.

Methodologies employed range from technology-centered approaches to contextual frameworks that consider the different aspects of the reality where the applications are inserted.

Technology-centered evaluation methodologies are mostly concerned with user requirement issues, appropriateness of hardware and software platforms, systems usability, acceptance and availability. An emphasis is placed on traditional models of measuring information systems technological performance and in determining what is "wrong" with a specific application and how it could be improved.

Contextual-centered framework constructions relate to how the evaluator organizes reality in an integrated whole of relations between the information system and the implementation environment. It also relates on how the healthcare information system is used and on the choices one makes when defining medical goals to be supported by the applications. The central activity of the evaluator is to build a contextual framework that includes the selective identification of relevant areas for evaluation and their structuring in a meaningful unity. Objective choices, economical, ethical, political, and cultural preferences play a major role in these constructions.

An evaluation model, recently proposed in the European Union, contemplates the five dimensions previously described in 5.3. to characterize the socioeconomic impact of Health Informatics and considers a mix of technology and contextual criteria and questions to be answered (Table 12):

Table 12. Evaluation of Health Informatics Impacts in Healthcare Systems (source: The Impact of Telematics on the Healthcare Sector in Europe, European Commission, DG XIII Report, July 1997)

DIMENSION	CRITERIA	OBJECT
1. IMPACT ON NATIONAL HEALTHCARE STRUCTURES	1.1. Representativeness	1.1.1. How far does the application represent the "state of the art"?
		1.1.2. How far does the application represent a particular typology (size, user groups, partnership, funding arrangements, policy initiative)?
	1.2. Goodness of fit	1.2.1. Does the application suggest new types of scenario not covered by previous experiences?
		1.2.2. Does it represent new organizational, funding

		and national or trans-regional arrangements?
	1.3. Policy impacts	1.3.1. What is the likely impact of the application on national/regional healthcare policy?
	1.4. Structural impacts	1.4.1. Effects on distribution and integration of services
		1.4.2. Displacement effects and additional functions
		1.4.3. Changes in reimbursement procedures and protocols
		1.4.4. Effect on the standardization and interconnection of technological platforms and application environments
2. ORGANIZATIONAL IMPACT	2.1. Changes in the organization	2.1.1. Effects in the distribution of services within and among organizations
		2.1.2. Integration of inter-departmental services
		2.1.3. Displacement of burden of care, redundancy, and additional effects, including need for support services and retraining
		2.1.4. Effects on the existing procedures and consequent to their reorganization
3. EQUITABLE ACCESS	3.1. Service provision effectiveness	3.1.1. Were improvements observed in service provision such as: increased coverage, reduced inpatient times, higher patient turnover, and reduced time/staff resources?
		3.1.2. Facilitation of interactions among service providers
		3.1.3. Improvement in the access and dissemination of knowledge and expertise

		3.1.4. Improvement in the monitoring of health conditions at community level 3.1.5. Facilitation of the decentralization of service management and provision of care
4. QUALITY AND COSTS	4.1. Technical effectiveness	4.1.1. Is the technology reliable? 4.1.2. What are the problems that users encountered in the utilization of applications? 4.1.3. How well applications inter-operate? 4.1.4. Level and degree of concurrent access to individual clinical data and aggregated community-based information 4.1.5. Gains resulting from communication of clinical and administrative data 4.1.6. Appropriateness of data-related standards 4.1.7. Impact on referrals, travel frequency and times, elimination of tasks and duplication 4.1.8. User satisfaction
	4.2. Cost-effectiveness	4.2.1. What are the development, capital and operating costs and how are they linked to other benefits? 4.2.2. What factors contribute to effectiveness or lack of effectiveness? 4.2.3. Role of different stakeholders and sustainability of deployed applications
5. CONSTRAINTS AND FUTURE PROSPECTS	5.1. Scenario development	5.1.1. What organizational changes need to be made to have more effective or acceptable applications?

		5.1.2. What technological improvements are required?
		5.1.3. Appropriateness of telecommunications infrastructure
		5.1.4. Are applications transferable to other healthcare domains or environments?
		5.1.5. What is the likely future demand for each specific application?
		5.1.6. Is funding flow adequate and was advantage taken from market opportunities?
	5.2. Policy relevance	5.2.1. What can be learned from the implementation that may affect or inform future policy?
		5.2.2. How well is the application integrated in the overall operation of the healthcare facility or delivery scheme?
		5.2.3. Is there a national set of norms and policies affecting the deployment of Health Informatics?
	5.3. Conceptual coherence	5.3.1. Are the applications and overall development scenario consistent with state of the art?
		5.3.2. Is it innovative?
		5.3.3. Is the technological configuration consistent with the aims and operational objectives of the application area and user requirements and expectations?
	5.4. Symbolic complexity	5.4.1. Are applications consonant with the environment context in which users live and work?

	5.5. Action contingency	5.5.1. Are users properly engaged and committed in how applications were specified, developed, implemented and operated? 5.5.2. Is there appropriate interactivity between different stakeholders?

11. A Plan of Action for the Deployment of Information Systems

The Presidential Declaration that followed the 1994 Summit of the Americas made clear that all countries of the Americas have a common stake in improving access to and delivery of healthcare through communications and information technology. Efforts involving the Pan American Health Organization and other stakeholders in fulfilling that mandate will necessarily concentrate on the public sector but must involve both the public and private sectors to result in a significant impact on the health of individuals and communities.

Joint investment and development involving users, governments, academic and financing institutions and agencies, technical cooperation agencies, and industry interests are seen as necessary, and projects have been started with the participation of the two major financing institutions in the Region, the Inter American Development Bank and the World Bank. Partnerships with the informatics industry are absolutely fundamental and, in the case of general informatics tools, the industry practically drives the solutions. A concerted effort is needed to secure a clearly defined and specified partnership with the informatics industry at the global and national levels aimed at application development at acceptable cost. Consistent to these objectives, the mission of the Pan American Health Organization to its constituency -- the public health sector of Latin America and the Caribbean Regions -- in the area of information systems, technology, and information systems management, primarily involves the transfer of knowledge, technical support, facilitation of the exchange of experiences between countries, and fostering the use of appropriate technology and knowledge assets. Areas of cooperation include: priority assessment, technology evaluation and selection criteria, implementation issues, emerging technologies linking patients and providers, access to knowledge databases, consumer informatics, and the utilization of Internet and Internet-enabled technologies.

11.1. Health Informatics Development Scenario

Clearly, there is great enthusiasm for applications of informatics in health, and valuable experiences are being reported from many institutions. The basis for a recommended development scenario is highlighted as follows:

- ***Health Informatics is appropriate for the Region***,
- ***National priorities and capabilities will determine Health Informatics deployment***,
- ***Appropriate strategy will ensure the success of project development,***
- ***Deployment and operational costs and obsolescence will be minimized, and***
- ***Interaction with the informatics industry will be promoted***.

PAHO's Health Services Information Systems Program

Recognizing the importance of information systems in the operation and management of health services, a new Technical Program -- Health Services Information Systems (HSP/HSI) -- was established in 1995 in the Division of Health Systems and Services Development.

The mission of the HSI Program is to promote, coordinate, and support the development of Information Systems and Information Technology required by health managers and professionals to deal effectively with the most relevant issues and priority problems related to the organization, operation, and management of health services.

The central concern of HSI is the cooperation with the countries in the promotion, development, implementation and technical assistance to systems and technological deployment, oriented toward the operation and day-to-day management of hospitals, clinics, and support services.

The following strategies guide the technical cooperation of the HSI Program with Member Countries:

- The primary strategic orientation addresses the functional aspects of Information Systems and Information Technology as essential resources for the operation and management of health interventions, organizations, and support activities, including planning, programming, execution, and evaluation processes.
- Managing knowledge, supporting the exchange of national experiences, and assisting information systems and information technology selection and deployment.
- Coordinated decentralization of systems development to promote the search for local solutions and shared resources.
- Mobilization of the expertise residing in Collaborating Centers, national academic and service institutions, and NGOs and stimulation of interprogrammatic and multi-institutional projects.
- Development of partnerships with the industry.

Priority areas of action of the HSI Program include:

- Specification of requirements for health services information systems, especially in the context of the emerging health care models being implemented throughout the Region.
- Promote the development of national policies and guidelines in the area of information systems.
- Human resource training and development in health informatics.
- Fostering the exchange of national experiences and expertise.
- Augmenting the utilization of resources present in Collaborating Centers, academic institutions and, NGOs.

Other PAHO established Technical Programs or Units involved in the development, implementation, or operation of specific information systems applications include: HDA/HDP (Health Situation Analysis Program), responsible for information systems related to mortality statistics, health indicators, and trend analysis; DBI (Publications and Editorial Services) and BIREME (Regional Library of Medicine), which beyond their more traditional role, also have assumed increasing responsibility for electronic publications and reference information access and dissemination; and finally, by a number of Technical Units that have, over the years, developed limited, specific, or specialized applications.

11.1.1. Health Informatics Embodies an Appropriate Set of Technologies for Latin America and the Caribbean Region

- The introduction and use of market-driven and sustainable health informatics and telematics applications in Latin America and the Caribbean will help improve healthcare and health status throughout the Region.

- To developing countries or communities, the Global Information Infrastructure offers the potential for a sizable leap in health, quality of life, and improved healthcare systems.

- Health informatics applications highlight the linkage between information and telecommunications and the healthcare system. From on-line information services to interactive multimedia educational materials and computer-assisted decision support systems, these tools have the capacity, when appropriately selected and deployed, to contribute to the operation and management of health systems. They support a new emphasis on wellness, prevention, shared decision-making, and better access and quality of care.

- Preference will be given to the deployment of Health Informatics applications taking advantage of existing technologies rather than developing technology to meet the expectations of possible healthcare applications. This is to avoid heavy investment in technologies that may not meet needs and to ensure that the infrastructure is scaled to the identified purposes, policies, and priorities.

11.1.2. National, Regional, and Local Health Systems and Socioeconomic Issues Are the Driving Force and Will Direct the Development of Information Systems

- Technology and applications will be designed and deployed to simultaneously address the immediate operational, clinical, and technical needs of the health sector to provide equitable and efficient quality services.

- The informatics industry can springboard social development and access to telecommunications infrastructure is critical to that dynamics. The impact of the technology, even in developed societies, is still elitist, affecting only a small number of organizations and individuals -- increasing access through the reduction of technology costs, infrastructure development and education are priority goals.

- Socio-ecological factors more than medical care or public health determine the health status differences observable between countries. They involve a complex web of social interaction, environment, and infrastructure that heavily influences the wellbeing and productivity of societies and their inhabitants. They involve such concerns as jobs, society organization, economic market development, communication patterns, organization of health services, individual and community

aspirations, personal and political relationships and diffusion of technology. They all must be considered when deploying telemedicine applications.

- Projects will search for and prioritize opportunities for product deployment that may contribute to the support of economic and social development, competitive advantage, effectiveness, and efficiency, considering feasibility, cost-benefit, and impact on accessibility and quality of healthcare.

11.1.3. Appropriate Project Development Strategy and Management Will Ensure Success

- The design, development, and deployment of applications will consider a strategy for action that looks at five components: national health framework and priorities, infrastructure, information products and services, market institutionalization, and leadership development.

- Because of wide variety among countries and even inside larger countries, evaluation of infrastructure, requirements, and possible solutions will be conducted on a case-by-case basis. Each project will have clear cost-benefit and impact analyses and indication of alternative solutions.

- International consensus on data-related, communications, medical vocabulary and coding standards; confidentiality protection; and the definition of common functionalities and minimum sets of data elements to be used by applications will be dealt with by extensive consultation with experts and technical or scientific organizations.

- Projects will search for partnerships to promote access to technology and project funding and will foster the sharing of knowledge and experiences among stakeholders and decision-makers.

- Projects will promote collaboration among users, governments, academic and financing institutions and agencies, technical cooperation agencies, and trade associations to advance infrastructure development and the adaptation of products and services to regional markets and application niches.

- The strategy will promote widespread education and training in Health Informatics preferably through distance learning techniques.

11.1.4. Deployment, Operating Costs, and Obsolescence Will Be Minimized

- Although each organization faces unique challenges, the following recommendations are worth considering in the evaluation of ways to reduce technology deployment costs while maximizing the contribution of the installed applications:

- Homogeneous environment
- Protection against obsolescence
- Centralization and automation of management functions
- Use technology to manage assets

- The drive toward a homogeneous environment tries to ensure that all acquired software, systems, peripherals, and other devices support the most recent technical and manageability standards, concomitantly minimizing the number of equipment configurations. In the highly dynamic environment of information technology, upgrading the installed base must be done according to defined configurations coupled with the aggressive retirement of legacy systems. One must, however, remember that some users may require non-standard configurations to do their job most effectively, but deviation from standard configurations should be based on demonstrated business need rather than personal preference. Continuity of unsupportable legacy configurations will be an ongoing management headache.

- As protection against early obsolescence, one should buy the highest performance systems that can support users' requirements and avoid premature retirement of equipment, basic software, and applications.

- One major problem for systems managers relates to user support. A strong user-training program is essential to reduce support calls and the centralization and automation of management functions should take advantage of "down-the-wire" or remote troubleshooting to resolve operational problems without the need for on-site visits. Remote management tools enable support staff to remotely access and control end-user systems without leaving their desks and play a significant role in reducing labor costs, speeding up problem resolution, and minimizing user downtime. Important savings of time and expensive technical resources can be achieved by the creation of inventory and fault management databases to track user configuration, problem history, resolution logs, and workarounds. Advanced technologies, like remote control and activity schedulers, should be used to automate information technology management functions such as backups and software distribution. One should not forget the importance of establishing desktop and server management policies that spell out in detail utilization and security issues.

- The technology should also be used to help manage assets wisely through the utilization of asset management databases to track moves, changes, and additions, including information about each machine "over the wire" in networked environments. A waterfall policy must be defined with the objective of redeploying old equipment to users who need less computing power and to remove systems that no longer meet the organization's guidelines.

Technology and Policy Objectives for Health Informatics and Telematics

1. DEVELOP A TELECOMMUNICATIONS INFRASTRUCTURE THAT IS COMPREHENSIVE, RELIABLE, UBIQUITOUS, AND COMPATIBLE ACROSS APPLICATIONS

Such an infrastructure should provide affordable band-width that is sufficient to serve users' specific needs. Its development will be dependent upon the continued deregulation of the telecommunications industry and will involve the leveraged use of many technologies that have been spawned by and for other industries

2. PROVIDE TECHNOLOGICAL INTERFACES THAT FACILITATE EFFECTIVE USE OF THE INFRASTRUCTURE AND ITS COMPONENT SYSTEMS

These interfaces may involve systems capable of rendering information from multiple sensory modalities, in conjunction with a variety of artificial intelligence applications as aids to decision making. They will require modularity, open architecture, and compliance with fundamental interface protocols. In the near term, emphasis should be placed on store-and-forward systems that require limited bandwidth and on means of providing home health care electronically.

3. SHAPE THE LEGAL AND REGULATORY INFRASTRUCTURE IN WAYS THAT WILL FACILITATE MEDICAL COMMUNICATION

At the professional level, such issues as interstate licensure and credentialing of physicians must be addressed. The telecommunications and information industries must develop rational and affordable tariff structures. Legislation must be passed to ensure the security of personal health information.

4. DEVELOP RATIONAL, TECHNOLOGICALLY NEUTRAL POLICIES FOR PUBLIC AND PRIVATE PAYERS

Coverage and payment policies should be established that cover the entire range of telemedicine applications and technologies. Means should be developed for assessing the appropriateness of health services provided via telemedicine. Outcome-based quality improvement programs will be of great importance in assuring quality, cost-effective medical care.

5. PROVIDE APPROPRIATE CONTENT TO CONSUMERS, PATIENTS, AND PROVIDERS THAT WILL ENHANCE HEALTH CARE OUTCOMES

The process for conveying information should permit the user to follow the links between data, inferences, and conclusions. Authentication, access control, confidentiality, integrity, and attribution are key requirements for health-related advice and decision making, and telemedicine systems must be designed to adhere to a high standard of auditability; an "anonymous" Internet will not suffice. It should be possible automatically to capture data on outcomes that result from decisions made on the basis of information provided by the system. The system should support an approach to outcomes research that will improve the quality of care.

(*excerpted from* Sandia National Laboratories, The Role of Technology in Reducing Health Care Costs, 1996)

11.1.5. Interaction with the Informatics Industry Will Be Encouraged and Joint Projects Promoted

- Differing national telecommunications regulations and issues of telecommunication pricing will be addressed.

- International requirements that constitute a challenge to the industry include the avoidance of proprietary bundled products. Projects will draw from the lessons of the computing industry by selecting independent components that enable the development of open, scalable, inter-operable, and affordable solutions.

- Projects will not start from scratch -- there is already a large repository of types of applications and assessment studies that can be used. This experience base is rapidly increasing worldwide and will be carefully analyzed and pondered *vis-à-vis* the requirements of each particular project and implementation environment.

11.2. Recommended Lines of Action for the Countries of Latin America and the Caribbean

Development of Health Informatics in the Region must be conducted in the context a framework linking public, private, and social efforts to speed the development of priority Information Technology solutions through the following lines of action:

- Promote changes in policies, regulation, and legislation in the area of telecommunications and informatics equipment;

- Develop infrastructure through core systems development and incorporating informatics into existing multilateral projects, supported by a combination of funding programs, incentive grant programs, and prototype application development funding programs;

- Develop technical guidelines, norms, and standards for mission critical projects;

- Establish education and training programs.

11.2.1. Policy, Regulation, and Legislation Reform in the Area of Telecommunications

Many Latin American and Caribbean countries are committed to reform their telecommunications systems. They recognize that progress in the telecommunications sector is essential to the establishment of health informatics and to ensuring the global competitiveness of their economies. In most of the markets today, telecommunication is now in private hands, and attention is focused on liberalizing the markets. To complete the telecommunications reform in the countries of the Hemisphere, the industry representatives from the private sector have provided recommendations over the past few years to both Trade Ministers and Senior Telecommunications Officials on a broad range of issues.

Demonstrating this commitment to reform, many countries from the region participated in the World Trade Organization (WTO) negotiations on basic telecommunications services now being concluded. As part of the negotiations, many of the region's leading economies guaranteed market access to international telecommunications services and facilities, agreed to permit foreign ownership or control of telecommunications services and facilities and market access for services and facilities (domestic and international), and pledged to implement pro-competitive regulatory principles. These commitments extended other international guarantees to the liberalization now underway in many countries.

Recommendations that are considered important to the development of Health Informatics in the Region are:

Market Access Issues

- Interconnection - Create a clear interconnection regulation framework.
- Clear and Transparent Regulations/Open Forum - Make all terms that govern competition available to the public and establish an independent regulatory agency.
- Allocation of Spectrum - Develop regulations that allow wireless solutions in harmonized spectrum bands.

Standards and Non-tariff Barriers to Trade

- Interoperability - Support the development of interoperability standards and intervene in regulated, franchised markets.
- Equipment Certification - Streamline and liberalize conformity assessment process for equipment certification.

Customs Procedures and Rules of Origin

- Avoid Rules of Origin provision related to telecommunications equipment and treat products from different countries equally when standards are the same.

Subsidies, Antidumping, and Countervailing Duties

- Rebalance telecommunications rates between local and international services, as local economic conditions permit.

Competition Policy

- Establish a regulatory framework that balances national needs in the context of creating a competitive national telecommunications system, weigh cost of delaying competition against need for an effective transitional regime, and move towards full liberalization as quickly as appropriate.
- Assess cost-benefit to country's economy when choosing between liberalization and the status quo.

Technology and Intellectual Property Rights

- Fight technological piracy and counterfeiting.

Investment and Services

- Attract investments to the telecommunications industry - Improve investment climates, lower duties on telecommunications equipment, and pose no restriction on network design except for technical reasons to allow for new providers.

- Establish more practical and flexible definitions of universal service goals and provide for access to local/long distance service, emergency services, etc., ensuring customers freedom of choice of services.

11.2.2. Infrastructure Development

The goal of establishing a Health Informatics infrastructure and strategy is to provide a coherent national arrangement directed to facilitating projects, infrastructure development, maximizing the benefits for invested financial resources, and enabling people to function more effectively. The objective is to develop core applications and support functions and to incorporate an advanced informatics component into existing multilateral projects, supported by a combination of funding programs, incentive grant programs and prototype development funding programs.

Given the fact that the worldwide market for information technology, products, and services is currently valued at US$853 billion, and that worldwide investment in telecommunications infrastructure is expected to exceed US$200 billion by 2004, developing countries need to find ways to share this growing trend. Domestic and foreign, public and private investment sources will be involved, ranging from revenue-sharing initiatives and joint ventures to direct investment, transfer schemes, major private financial institutions, loans from international funding agencies and development banks, and incentive grants.

Search for Funding

- Collaborate with national and international authorities and experts to ***encourage lending institutions to fund projects*** by demonstrating that social projects, especially healthcare and education, can be advanced through improved information infrastructure.

Priority Area Projects

- Promote, along with all stakeholders, including the private sector, the initiation of ***projects*** that can rapidly demonstrate the benefits of informatics and telecommunications in the health sector, with ***emphasis on opportunities for the participation of national and multilateral stakeholders*** and assigning ***higher priority for innovative applications of information technology in the solution of problems of access to and quality of healthcare services, access and dissemination of knowledge, and service management*** .

- Promote the ***sharing of experiences*** among countries on government-funded and private sector projects and applications.

- Develop a ***services and resources database.***

- Infrastructure development will be directed by the following ***tactical approaches***:

    - Promotion of ***national planning capacity in information systems and information technology***;

    - Alignment of information infrastructure with healthcare ***organizational goals and priority needs***;

    - Electronic ***connectivity*** among healthcare providers, universities, ministries, regulators, and payers;

    - ***Systems Integration*** to enhance effectiveness and lower costs;

    - Improving the ***capabilities of human resources***;

    - Creating information architecture and infrastructure ***to enhance effectiveness, efficiency, equity, and quality of healthcare***;

    - ***Updating obsolete systems;*** and

    - ***Improving systems development processes.***

    - Consider top ***emerging technologies in developing applications***: Internet; Groupware; Knowledge Management; Broadband Technologies; New User Interfaces; Wireless Communication; Modeling and Simulation.

- ***Priority project areas identified and recommended*** by the Inter American Development Bank "Informatics 2000" Health Task Force and the Pan American Health Organization:

    - ***Distance Education for Health Professionals***

    - ***Linkage of Health Institutions and Practitioners***

    - ***Norms and Standards***

    - ***Unified Health Record (Electronic Patient Record)***

    - ***Clinical and Administrative Information Applications***

    - ***Telehealth Core Applications***

- ***Process Management Applications***
- ***Health Status and Epidemiological Information Monitoring***
- ***Community Health Call Center Systems***
- ***Consumer Education and Health Promotion***
- ***Health Informatics Products and Services Resource Center***
- ***Regional Steering Consortium for Health Informatics***

Access to Connectivity for Health Professionals and Organizations

- ***Message Switching*** - Existing technologies include text e-mail for Internet users, text newsgroups for Internet users, proprietary or local network software, multimedia mail/newsgroups, and list processors. Recommendations:
  - Start deploying simple message-switching applications whenever and wherever possible, particularly in areas where telecommunication infrastructure is mainly low-speed. Make the most out of this technology, by providing local equipment (computers, modems, software, and telephone lines) to end-users. Where no Internet providers are available, encourage the deployment of Bulletin Board Services (BBS). Train end-users in the whole range of possibilities of using the technology. Provide for the establishment of a decentralized, intensive network of information providers, "on-line" physicians and nurses.
  - Disseminate information about the existence of these services and resources.
  - Promote the establishment of resource centers, such as inexpensive, voluntary-based information centers.
- ***File transfer*** - Existing technologies include FTP Internet protocol; proprietary or free-domain alternatives (BBS); point-to-point file transfer (embedded or non-embedded); character oriented command lines, or interactive, Windows-based software, and FTP servers. Recommendations:
  - Start deploying simple file transfer applications whenever and wherever possible, particularly in areas where Internet access providers still do not offer SLIP/PPP technology.

- Make the most out of this technology, by providing minimal local infrastructure (computers, disks, modems, software, telephone lines) and training to end-users.

- Where no Internet providers are available, encourage the deployment of BBS and establish a number of specialized-domain file servers and a network of voluntary information providers.

- Disseminate information about the existence of file server resources.

- ***Remote Execution*** - Existing technologies include: TELNET or RLOGIN software; remote timesharing terminals on multi-user systems or PC LANs using dial-up connection, dedicated line or radio bridges; and point-to-point synchronous communication between stand-alone systems. Recommendations:

  - Try to restrict pure TELNET applications to those areas that justify remote execution and access to large-scale resources, which depend on large storage and/or speed of host systems.

  - Try to integrate TELNET applications to GII technology, such as the Web.

  - Convert legacy systems to new interactive multimedia technologies, if possible, because conversion facilitates user training and access where the appropriate infrastructure is available.

- ***Distributed Interactive/Multimedia*** - Existing technologies include Internet; Web servers and browsers; static or on-demand streamed video and audio; workgroup software; IRC (chat) and multicasting technologies; integration with client-side applications; and distributed execution. Recommendations:

  - These are going to be the predominant technologies in local area, wide-area, and global networks in the foreseeable future, mainly due to their appeal to users and the range of network services that have been and will be deployed. When the telecommunications and computer link so permit, this should be the point of departure for many of the networked activities in healthcare and education. When not, the local, regional and national authorities and users should press for upgrades in the infrastructure that would permit it.

  - The development and deployment of gigabit/sec networks is within the immediate future (two to three years). The same will happen with wireless digital networks based on upcoming worldwide low-altitude satellite (LEO) coverage. These technologies will dramatically modify the technical basis of the communication infrastructure, as well as the economic factors of its financing and operation. Satellite networks, particularly, will offer in the future the possibility of bypassing entirely the deployment of costly fiberoptic

networks in developing countries, increasing the number of people accessing the Internet.

- Intranet technology based on the Web paradigm will be taking the health sector by storm in the next years, due to its many advantages (low cost, quality and scope of information, attractiveness to the users, low training requirements, etc.). This will made the use of similarly based wide-area and global network usage for healthcare and education even more advantageous.

11.2.3. Development of Norms and Standards

The healthcare information infrastructure requires ***the integration of existing and new architectures, application systems, and services***. Core elements of this infrastructure must be able to deal with data related to health status and epidemiological variables, patient-centered information systems, continuity of care resources, facilities to measure outcome, clinical and management support systems, and facilities to allow billing, reimbursement, and auditing of services provided.

- Work with the public and private sectors to ***achieve consensus on a set of information principles for the collection, transfer, storage, and use*** of health data over national and global information infrastructures.

- Standards will be defined by a consortium of users, researchers, government, and technical and scientific bodies and industry at three distinct levels. First, in terms of standardization of **data and information**. Second, in terms of the computational **facilities** required to manipulate and store the information. Third, in terms of **telecommunications** facilities, employed to transfer information among dispersed sites.

- ***Standards will include*** definitions for the following ***areas***:

    - Patient identifiers;

    - Provider identifiers, site of care identifiers, and product and supply identifiers;

    - Communications (message format);

    - Content and structure for the medical record;

    - Clinical data representation (codes); and

    - Confidentiality, data security and authentication, and quality indicators.

- Identify key ***privacy and confidentiality issues*** that need to be addressed, encouraging the use of voluntary ***guidelines*** developed by international bodies.

- Preventive ***legislation*** proposals will be initiated to ensure that the technology does not abridge patients' rights to confidentiality or security of medical records, and that agreement on practice parameters be developed to include aspects related to ***informed consent, physician liability, non-physician liability, reimbursement, practice parameters, and physician-patient relationships***.

11.2.4. Human Resource Development

Human resources development through awareness programs, education of health staff, continuous training, and career opportunities will be institutionalized from the inception of the developmental effort. ***Transference*** of technical expertise and the ***appropriation*** of knowledge by health personnel are necessary for the full participation of end-users in the development process and the best insurance for a successful implementation. Critically the ***success of a project depends on the existence of an information systems staff with the right mix of skills*** and it rests on people in all functions and levels. They must have good awareness of the principles of information systems management.

The following ***strategy*** will be used:

- A **structured** human resource development program will be defined to increase awareness, to assess training needs, and to involve the staff in all aspects of systems design and implementation.

- Ensure that ***staff involved in all levels*** of systems implementation and operation are identified and selected to receive appropriate training, both theoretical and practical, in health information systems, systems technology, and management of the information function.

- The training strategy will take into account issues associated with ***the development and the organizational environment*** in which systems are expected to operate and the specific circumstances of the local health system. The following **guidelines for training** will be implemented:

    - Identify ***target groups*** on the basis of functions and training needs.

    - ***Develop training programs*** to meet identified target groups' needs.

    - Establish a ***network of training focal points,*** which takes account of the organization and circumstances of national characteristics and local health unit requirements and undertakings.

- The following ***target groups*** will be considered: those who originate, collect and supply data; operational decision makers (direct healthcare professionals and administrators); managers, planners, and policy makers; information systems managers; information technology and computing specialists; data analysts; and statisticians and researchers.

- Each country will develop its own **strategy** for initial and continuing training in health information systems, which takes into account the overall development of health information systems and its particular healthcare, educational, research, and market environment.

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