

# A Case Analysis of INFOMED: The Cuban National Health Care Telecommunications Network and Portal

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## ABSTRACT

The Internet and telecommunications technologies contribute to national health care system infrastructures and extend global health care services markets. The Cuban national health care system offers a model to show how a national information portal can contribute to system integration, including research, education, and service delivery as well as international trade in products and services. The objectives of this paper are (1) to present the context of the Cuban national health care system since the revolution in 1959, and (2) to identify virtual institutional infrastructures of the system associated with the Cuban National Health Care Telecommunications Network and Portal (INFOMED). Qualitative case research methods were used to identify the integrated virtual infrastructure of INFOMED and to show how it reflects socialist ideology. Virtual institutional infrastructures include electronic medical and information services and the structure of national networks linking such services. Analysis of INFOMED infrastructures shows integration of health care information, research, and education as well as the interface between Cuban national information networks and the global Internet. System control mechanisms include horizontal integration and coordination through virtual institutions linked through INFOMED, and vertical control through the Ministry of Public Health and the government hierarchy. Telecommunications technology serves as a foundation for a dual market structure differentiating information and research from products and services offered on international health care markets. Transferability of this model is contingent upon system ideology and interpretation of values such as individual intellectual property and confidentiality of individual health information. Future research should focus on examination of these issues and their consequences for national health care systems.

## INTRODUCTION

National health care systems are motivated by highly diverse ideologies giving rise to consumer driven as well as social medicine models delivering widely varying quality of health care. Health care is defined here as the preservation of mental and physical health by prevention or treatment of illness through services offered by the health professions.[1] A health care system is a dynamic set of interconnected individuals, institutions, organizations, and projects offering products and services in health care markets.[2] The boundaries of such systems are increasingly difficult to identify. While many analyses such as the World Health Organization's annual reports refer to national health care systems,[3] diverse system boundaries may also be

defined by overlapping corporate, professional, or other social entities.

Virtual infrastructures refer to (a) an environment characterized by overlapping distribution networks, systems brokerage functions, and the adoption of a software perspective emphasizing the devices and channels through which information is processed and distributed, as well as (b) a layer of abstraction between the computing, storage and networking hardware, and the software technologies that allow multiple operating systems to run on the same processor. This layer of abstraction leads to standardization and the support of legacy operating systems and applications on current hardware and software platforms. These infrastructures in turn are accessible through Internet websites and gateways designed to facilitate integrated use of the resources offered through virtual infrastructures. The adjective "virtual" thus describes any web-based product, service, organization or institution arising from the technical infrastructure defined above.[4]

International trade in health care services and the globalization of national economies raises questions with regard to emergence of institutional infrastructures in light of the deepening divide between the wealthiest industrialized nations and the developing world. Internet and telecommunications technologies are contributing to emergence of health care markets around the world. Research on economics and health care services has shown that national system performance is not directly related to GNP,

but rather a function of variables describing rate of investment in public health as well as mechanisms for the equitable distribution of wealth.[5-7] Health care systems deliver widely differing services in terms of overall performance and per capita cost. This economic analysis is validated in the rankings of general performance of national health care systems published by the World Health Organization in 2000.[3] For example, the general performance of the U.S. health care system in translating expenditure into health was ranked 37th and the Cuban system is ranked 39th of 191 member countries. Total health care expenditure per capita was more recently estimated at international dollar rates (2003) at \$5,711 in the US and \$251 in Cuba.[8] The level of expenditure in the U.S., highest among OECD member countries, is not reflected

in health care system performance measured as life expectancy among OECD nations.[9] Despite resource constraints,[10] the Cuban National Health Care System has achieved a significant level of health care quality and equity as measured by population health criteria: the highest life expectancy in the Caribbean region as well as the highest concentration of physicians in the world. According to the United Nations Development Program, there were estimated to be 591 physicians per 100,000 population in 2004.[11] Thus institutional configurations and their underlying social logics or ideologies are hypothesized to account for some of this variance in health care system performance. Ideology is the body of integrated assertions, theories and aims that constitute a coherent socio-political system. Health care system ideology is expressed as the extent or manner of government and other stakeholders' involvement in the financing, administration and regulation of health care.[12, 13] Indicators of such involvement include investment in health care, oversight and control of health care services, as well as ownership and governance of the health care system. Research on the association between ideology and health care system structures, processes, and performance remain inconclusive.[14-20] From a methodological perspective, it is important to consider the complex system level of analysis and the proposition that system performance may be better explained by the internal coherence of the system, including the fit between system configurations and market ideologies as well as their integration in global networks and their adaptability to rapidly changing political and economic environments.

### RESEARCH PROBLEM

The Cuban strategy for an information society recognizes the critical importance of linkages among research activities and all economic sectors of activity including health care. The accomplishment of this objective depends upon universal application of information technologies and development of national innovation systems and networks. The Cuban systems perspective on health care integrates evidence-based practice as well as medical and social science criteria for evaluation of system performance.[21, 22] Of pivotal concern in analysis of the Cuban case are the socialist ideological principles upon which technological and institutional infrastructures are founded.[13, 23, 24] These principles, particularly social welfare priorities of free and equal access to health care and education for all Cuban citizens, affect the social and ideological pattern of interaction between telecommunications technologies and institutional choices within the society. Social behavior and community participation shape technological development by a process reinforcing institutional structures as well as organizational adaptation.[25, 26] In the centralized Cuban social-medicine model, unique social control structures suggest that the role of technology is significantly different from that in the free health care market driven by consumer demand.[27] However, little research has examined specific institutional network configurations serving health care systems with the emerging roles of virtual infrastructures.

The objectives of this paper are to present the context of the Cuban National Health Care System since the revolution in 1959, to identify the configuration of INFOMED and its virtual institutional infrastructures using a qualitative case research methodology,[28] and to describe how these infrastructures contribute to health care

service delivery and linkage to international health care services markets.

### RESULTS: CASE ANALYSIS

#### INFOMED and the Cuban National Health Care System

The Cuban health care system integrates the *family doctor-and-nurse* model founded on the social relationship among patients, families, and their physicians specialized in comprehensive general medicine. A key characteristic of the model is participation of the family as a social unit with attention to social morbidity as well as family culture and environment.[29, 30] Family doctors usually assisted by nurses serve neighborhoods of approximately 150 families whom they know intimately.[31] Community and family participation throughout the system, as well as continuous individual medical assessment (*dispensarización*) link the collective and individual levels of health care.[32] While population level data are analyzed for performance evaluation and policy making, individual patient histories are often maintained in paper files considered critical for the legal record of patient care.[33, 34] Both qualitative and quantitative data are required for evidence-based medical practice, administrative coordination, community participation, and health care system evaluation.

Since the Cuban revolution in 1959 Fidel Castro and the country's leadership have pursued strategies to integrate national research and innovation policies in health care through development of traditional institutions and, since 1990, virtual infrastructures.[35-39] International organizations collaborated for the development of INFOMED when it was founded in 1992 with creation of the national network node in Havana. The United Nations Development Program, the World Health Organization, the Pan-American Health Organization, and UNICEF made significant financial contributions to this effort. The INFOMED network extended throughout the 14 Cuban provinces became critical for health care workers' access to information - connecting provincial information centers, research institutes, hospitals and universities. These infrastructures reduce institutional health care costs, particularly under difficult economic conditions including the collapse of the Soviet Union as well as sanctions imposed by the U.S. government.[38, 40, 41]

The INFOMED network and the Cuban Ministry of Public Health (Ministerio de Salud Pública - MINSAP) assure both horizontal coordination and hierarchical control of the Cuban National Health Care System.[40, 41] The hierarchical organization of MINSAP is comprised of twenty-two functional areas including health statistics, hospitals and ambulatory care managed through the ministry and its board of directors as well as institutions at the national, provincial and municipal community levels. At the municipal level, the people's assembly, basic work groups (*grupos básicos de trabajo*) and the family doctor contribute to local health care management. Government, health care institutions, and mass organizations such as youth and women's groups are integrated in a distinctive social control system.[42] [27]

While MINSAP is largely responsible for hierarchical control, the information portal and network, INFOMED, is the vehicle for horizontal communication and coordination throughout the health care system. INFOMED also supports international collaboration

and dissemination of information as well as the growing international trade in Cuban health care services. The virtual infrastructure maintained through INFOMED includes the Virtual Library (*Biblioteca Virtual*), Virtual University (*Universidad Virtual*), and a continuous health care information observatory (*Vigilancia en Salud*) accessible through the gateway. The current mission of INFOMED is to develop an integrated telecommunications network for access and management of information and knowledge for improvement of clinical care, training, research and health care management systems. Its objective is to improve the efficiency of the Cuban National Health Care System through development of an advanced electronic information infrastructure to foster communication and interaction between the international scientific community and Cuban health care workers including clinicians, educators, administrators, professionals and technicians.[43] Furthermore INFOMED is designed to offer timely information access required for optimal work performance without regard for physical location or the technical characteristics of work stations. Important strategic objectives of the network are to: [44]

- Facilitate electronic information access through the Virtual Health Library linked to provincial resources as well as regional and international databases available on the Internet. (*Biblioteca Virtual en Salud-BVS*).
- Create an infrastructure of technical, organizational and human resources for sustainable growth of INFOMED.
- Facilitate continuing education for health care professionals through the Virtual University (*Universidad Virtual*).
- Maintain a continuous health information observatory through the National Office for Analysis of Health Care Trends.
- Develop specialized telemedicine networks for services consistent with levels of telecommunications infrastructure throughout the country.
- Facilitate communication and create a virtual workspace linking health care institutions within Cuba and outside the country.
- Develop software and methods for implementation of projects designed according to the INFOMED model.
- Promote Cuban scientific research and publication in the field of health information science.

The Virtual Library (*Biblioteca Virtual en Salud-BVS*) integrates access to Cuban electronic publications in medicine and public health (more than 40 online journals) as well as important U.S., Latin American and international publication initiatives. Medline and the U.S. National Library of Medicine offer subscribed English language bibliographic databases while SCIELO, the Latin American Scientific Electronic Library Online initiated in Brazil offers medical journals by country of publication (Brazil, Chile, Cuba, Costa Rica, Spain and Venezuela) in English, Spanish, and Portuguese. The INFOMED website offers a search tool, the reference locator for local, national and international health information resources (*Localizador de Recursos de Información de Salud – LIS*). INFOMED also provides access to the Health Inter-network, (HINARI) launched in September, 2000, by the United Nations and the World Health Organization to promote institutional electronic access to medical publications in the developing world.[45] Thus the Virtual Library integrates resources from the developed and developing world including the most advanced scientific research, accounts of medical experience in develop-

ing countries, and documentation of natural and traditional approaches to medicine.

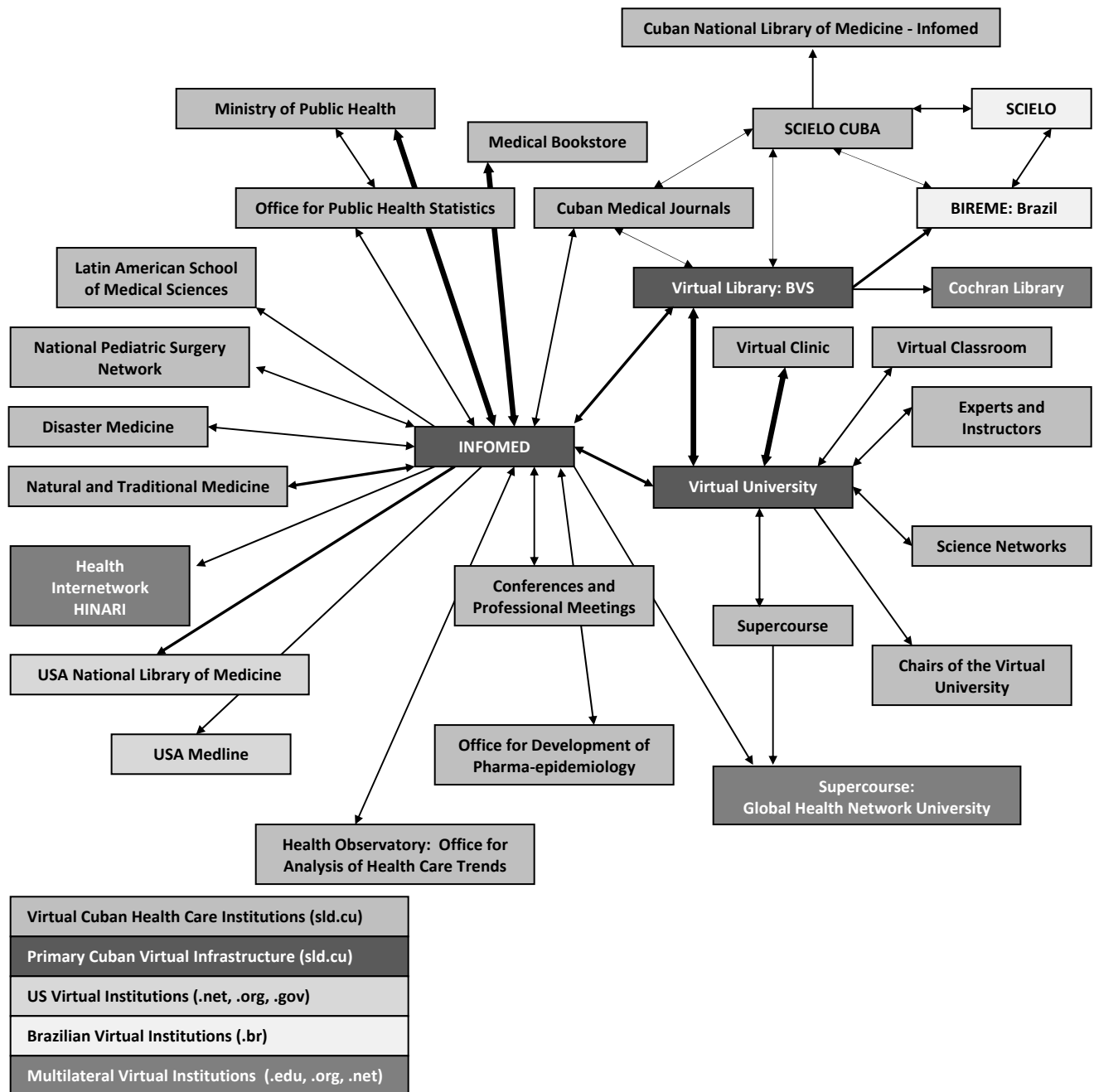
The Virtual University project was inaugurated by the Ministry of Public Health in 1999 to improve continuing post graduate medical training for more than one hundred thousand Cuban health care professionals and to create an international center for postgraduate education in medicine and related disciplines. [46] The Virtual University is now part of the National School of Public Health (ENSAP) and the National Medical Sciences Information Center (CNICM) through INFOMED and integrates all of the institutions of the Cuban National Health Care System, thus extending its institutional scope throughout the country.[47] This institution links the Cuban health care information and publication infrastructure with Cuban institutions for higher education, and it offers access to Cuban as well as international content such as the supercourse, *Epidemiology, the Internet, and Global Health*. [48] As part of the Virtual University, a Virtual Clinic offers expert consultation among the physicians and health care professionals associated with the University. When authorized, consultations of particular pedagogical value are published for the benefit of other users of the clinic. The interactive design of the Virtual University promotes an information market for shared expertise and learning serving the Cuban National Health Care System as well as external markets.

INFOMED offers a strategic infrastructure also serving evidence based practice of medical specialties. An example is the Cuban Pediatric Surgery National Network (Red Nacional de Cirugía Pediátrica - RENACIP). The Cuban Ministry of Public Health designated the lead network institution, the Paediatric Teaching Hospital “*Octavio de la Concepción de la Pedraja*” of Holguín, in 2001. [49] The objectives of the network are to develop of the specialty of pediatric surgery throughout the country, to make available high quality research results for the practice of this specialty, and to link the resources of all the participating health care institutions across the country. Local area networks of hospitals were linked to integrated services in radiology, endocrinology and neurophysiology through the INFOMED Portal. Regional experts in pediatric surgery are identified for participation in discussion lists on cases treated by designated experts or through collective consultation and analysis.

This network makes possible expert intervention in real-time treatment when required, as well as focused use of limited resources. Evidence-based protocols for best practice are developed using virtual analysis as well as face-to-face discussion for approval. Key features of the system include software development and websites,[50] a specialized virtual library, and alliances with provincial universities and enterprises. This model is under development as it is extended to other medical specialties.

Figure 1 shows the configuration of INFOMED and the institutions of the Cuban National Health Care System to illustrate how the infrastructure is integrated and how it is linked to international institutions. The primary virtual infrastructure includes INFOMED, the Virtual Library (*Biblioteca Virtual en Salud-BVS*), and the Virtual University (*Universidad Virtual*). These features of the health care information system have contributed to extension of the family

Figure 1: Institutional Configuration of INFOMED and the Virtual Infrastructure of the Cuban National Health Care System



doctor-and-nurse model of primary care, increased interdisciplinary integration of the activities of diverse health care actors, and emphasis on continuous data collection, analysis, and dissemination throughout the system.[51] This system continues to evolve as the important parallel dynamics of institutional decentralization and network integration converge.[44]

**International Collaboration and Trade in Health Care Services**  
 The INFOMED infrastructure plays a key role in development of the Cuban contribution to international trade in health care ser-

vices. Globalization of the health care sector is based on the decline in public sector expenditure, growing private health care enterprise, deregulation in insurance and telecommunications sectors, growing mobility of both consumers and healthcare service providers, and cross-border ecommerce for delivery of both health care products and services. There is also a high degree of variability in cost, availability and quality of health care among national health care systems. This context motivates consumer mobility as well as new international opportunities and global patterns of investment.

Cuban international trade in health services is made possible through its competitive research in specific areas of medicine and medical informatics, the quality of its education and health care services, its high concentration of physicians and health care professionals, its health care information and telecommunications technologies, and the exportability of certain aspects of its social medicine model to the industrialized as well as the developing countries. Because of trade restrictions under the U.S. embargo and other resource constraints, electronic trade in information and education is more highly developed than conventional cross-border trade.


The Cuban strategy in research and development in the field of biotechnology incorporates both physically proximate and virtual infrastructures.[52-54] Development of Cuban biotechnology is led by the Cuban Center for Genetic Engineering and Biotechnology (CIGB) and the Western Havana Bio-Cluster of 52 specialized institutions.[55] The Western Havana Bio-Cluster offers a physical environment fostering inter-organizational exchange of research and ideas, while the CIGB promotes development of an extended virtual network of collaborators through their Internet presence. The CIGB Business Development Group negotiation policy for alliance agreements outlines conditions regarding scientific collaboration in research and development. Growing joint enterprises with foreign firms in medical research and biotechnology contribute significantly to research, development and international marketing of new Cuban products.[56-58] For example, the CIGB has made its software "Isotopica" freely available to registered users as a web application for research in the field of proteomics – the study of the structure and functions of proteins – with the collaboration of the Japanese Institute for Protein Research of Osaka University.[59] This offering extends opportunities for research collaboration with partners in the developed as well as the developing world. Other institutions contributing to international research and development in biotechnology include the Finlay Institute, the Center for Molecular Immunology (CIM), and the National Center for Scientific Research. Despite many political and economic challenges, Cuba has developed a significant presence in international health care services markets including scientific collaboration.

## CONCLUSIONS

Analysis of INFOMED in the context of the Cuban National Health Care System has shown the critical role of virtual infrastructures in development of services to Cuban citizens as well as growing clientele in global health care services markets. Of particular importance

is the coherence between design of the system and the socialist ideological values of its institutions: the ethic of universal and free access to health care services as well as attention to the collective social and environmental dimensions of health.[60] The unique features of the Cuban model enhanced by INFOMED include:

- A systems perspective integrating health care service delivery, research, information resources and education.
- Horizontal coordination and integration through INFOMED and telecommunications infrastructures with vertical control through MINSAP and government hierarchy.
- Government and health care administration serving social control, universal citizen access and humanitarian service.
- Emphasis on individual assessment and community health evaluation including physical and mental health dimensions.
- Priority on holistic, preventive health care in the family context rather than in specialized health care institutions.
- Emphasis on original research and innovation in medicine, medical informatics, health care management and related disciplines.
- Recognition of the importance of methodological considerations in elaboration of data collection and information systems.
- Effective mobilization of information and telecommunications technologies to achieve horizontal and interdisciplinary integration of the health care system and to promote Cuban contributions to international health care services trade.
- Dual health care service market structure with emphasis on open information markets in education, research and practice supporting trade on international services markets.
- Strong emphasis on training and education of highly qualified physicians and other health care personnel as well as their indoctrination with values of humanitarian service for the collective good.

The Cuban health care model may be characterized as 'high tech-high touch',[61] integrating a high concentration of health care professionals as well as the highly developed telecommunications and information systems of INFOMED. Health care is viewed as a social process and a responsibility distributed throughout all levels of society.[62, 63] The transferability of the Cuban model to other national settings is contingent upon interpretation of fundamental values such as individual privacy, intellectual property, and the common good.[64-66] More extensive qualitative case analyses of complex health care systems will contribute to better understanding of ideological diversity and the role of telecommunications and virtual infrastructures in integration of global health care markets. 

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