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Chapter 5

Organizational Models of Telemedicine and Regional Telemedicine Networks

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INTRODUCTION

THIS CHAPTER REVIEWS the organizational models in telemedicine including an assessment of their successful attributes. This is followed by a discussion of the concept of regionalization in medical care delivery and its relevance to telemedicine networks, together with a summary of issues pertaining to the planning and implementation of regional, national, and international telemedicine networks. Also included is a select review of telemedicine network developments at the regional, national, and international levels. The chapter concludes with recommendations for research and policy development designed telemedicine networks at all geographical scales of development.

ORGANIZATIONAL MODELS

Over the last 30 years, a variety of organizational models for telemedicine networks has emerged along with the evolution of the field. Predominantly, these organizational models have been generated in response to:

- Interests of funding sources or sponsoring institutions;
- Attempts to meet the unmet health care needs of geographic regions of varying size from a small region to states and entire countries;
- Lack of access to essential medical services (primary care and/or specialty care) in remote areas; and
- Need to provide access to medical care services for selected target populations.

Nevertheless, all telemedicine efforts and related organizational models share the common goal of promoting the transfer of health related expertise over distance to improve the health of a target population. In efforts to achieve this goal, a number of organizational models have been developed. It should also be mentioned that there are few mature and self-sustaining telemedicine systems. This has important implications in determining the relative success of the various models observed, as discussed later in this chapter. Nonetheless, despite the variety and nascent and, in some instances, short-lived nature of many telemedicine networks and projects, it is useful and instructive

to attempt a general classification of these models. Such a classification will enhance our ability to evaluate networks and permit objective assessments of their performance and their outcomes pertaining to stated goals. Despite internal variations, most organizational models can be classified into four general, but not mutually exclusive, categories. Within each category, a model may share certain characteristics with models in other categories. We can classify the four models based on:

- Size and complexity of geographic service area, such as regions, states, or countries;
- Target population groups, including rural and inner-city populations, institutionalized populations such as those in long-term care facilities and penal institutions, members of managed care plans, and armed forces members and dependents;
- Single- and multi-purpose medical specialties or disease entities, such as dermatology, diabetes, or comprehensive cardiac care; and
- "Open" or "closed" systems, as defined by a target client population.

Geographically based models provide medical and health services to people residing in a defined geographic region within a state, an entire state, a whole country or a group of countries. At each scale the designated target area may or may not be geographically contiguous. For example, in the United States, the Georgia Statewide Telemedicine Program ostensibly serves the entire State of Georgia. The Arizona Telemedicine Program serves a large portion of the State of Arizona, several correctional institutions in the state and international partners. The Mayo Clinic Telemedicine Program, based in Rochester, Minnesota, has links with affiliated clinics in Jacksonville, Florida, and Scottsdale, Arizona, in addition to international links with Amman, Jordan, and several medically underserved areas of the United States. In Europe, the National Center for Telemedicine serves the northern region of Norway. In Toulouse, France, the Regional Telemedicine Network in Mid-Pyrenees Province serves the Mid-Pyrenees Region, as well as locations in several other countries. The most notable and geographically comprehensive national telemedicine program is that of Malaysia. Here, the government developed a comprehensive program as part of its national health plan to meet the needs of the entire population.

Population-based models are designed to meet the health care needs of a defined population, which typically receives its health services based on entitlement. These include institutionalized populations such as inmates of correctional institutions and residents of long-term care facilities, as well as service groups such as members of the armed forces, and patients enrolled in the Veterans Administration Health Service. The Veterans Health Administration has an active program in its various administrative regions throughout the United States. The U.S. Army has an active telemedicine program together with a high-level research center, the Telemedicine and Advanced Technology Research Center. The Center facilitates development of operational and peacetime telemedicine applications along with advances in medical informatics, such as the high capacity medical record, known as Personal Information Carrier (PIC). The U.S. Navy's Program provides services to its personnel aboard ships on a worldwide basis.

Specialty- or disease-based models use technologies to draw together clinical, research and educational efforts that address a specific clinical or a set of clinical services to assist people with certain illnesses. There are many examples of this type of model and only few are mentioned here as illustrations. In the United States, the Centers for Medicare and Medicaid Services (formerly the Health Care Financing Administration [HCFA]) recently provided funding for a consortium of health care groups and providers to install Internet-based telemedicine technology in homes of hundreds of low-income diabetic patients living in medically underserved areas of New York State. The object of the 2-year project is not only to improve care, but also to determine the cost-effectiveness of the technology.[1] This is a particularly important project because it is designed as a randomized clinical trial.

In Europe, the European Commission (DG XIII Information Society) provided support for the Black Sea Tele Diab system project. The system provides clinicians in countries of the Black

Sea area with a computer-based diabetes health care record system in order to promote the electronic exchange of health care information between clinicians and scientists in these countries.[2,3] The European Commission-DG XIII also sponsored the Remote Diagnosis, Management, and Education in Congenital Heart Disease telemedicine project involving the United Kingdom, Greece, and Portugal. In Italy, the Ministry of Public Health initiated a 3-year pilot project in Trento Province using ISDN technology over a Wide Area Network. The project provided comprehensive oncology services for providers and their patients in seven rural hospitals in the region.[4]

Finally, telemedicine systems may be open or closed. Open systems permit global access to expert health knowledge without the barriers of health professional licensure or conflicting health policy agendas. For example, the Partners Online Specialty Consultation Program provides global access to its specialists through its Web site. Launched on July 1, 2001, the program provided care to 509 patients across the globe in its first 6 months of operation. The Global Grid Telemedicine System (GGTS) is a global telemedicine command and control system that allows telemedical consultations to occur anywhere in the world, regardless of location or transportation modality. The GGTS is unique, as it is software based and not solely reliant on human interaction for consult-requestor linkage.

Typically, programs that offer services to institutionalized or other specified target populations are, by definition, closed systems, because their clients (patients/users) are limited to specific target populations in specified institutions. The most significant barrier met by closed systems has been the lack of appropriate technological infrastructure among its end user clients. Funding sources of closed systems or laws often dictate the terms of entitlement in closed system.

For more examples, see the following Web site: www.ntia.doc.gov/otiahome/top.

SPECIAL CASE CLOSED MODELS

The following brief discussion of what might be termed the "military model" of telemedicine is provided as a special case. Military telemedicine does not face the usual problems seen in the private sector pertaining to licensure, reimbursement, and liability. However, it faces unique challenges in complexity in meeting the needs of its populations from all areas around the globe. Hence, the military telemedicine experience may offer additional insight into the development and success of other types of organizational models. Moreover, in the military sector, there is only one payer, and the service population is constrained in the availability and choice of medical care. In certain respects, military telemedicine is unique in terms of its organization and implementation. It is an example of a "tightly" closed model with a number of special and singular characteristics, and it may not serve as a versatile model beyond the military sector. Nevertheless, important lessons can be learned from this system. In addition, the military has served as an important test bed for new technologies that can be applied in the public and private sectors.

Medical support for United States armed forces involves providing medical care in distant countries. In addition, combat troops are generally "on the move," and the medical facilities that serve them must be mobile as well. Because of the unique conditions of many military operations, the infrastructure requirements—such as transmission speed and ready availability of information—are of paramount importance. During peacetime, military troops increasingly are deployed to many parts of the globe to support humanitarian, peacekeeping, and disaster relief missions. These missions often face significant logistical problems as well as mechanisms for maintaining and making readily accessible large volumes of patient records. In both combat and humanitarian missions, these records must be transmitted so that forward medical personnel have adequate information to treat a casualty, an illness or an injury.[5]

The U.S. Navy Business Office is actively deploying teleradiology capabilities in all ships in the Navy fleet. A similar effort is underway in the U.S. Air Force. The National Aeronautics and Space Administration (NASA) has had a long-standing interest in the applications of telemedicine in medical monitoring of astro-

nauts in space.[6–8] Similarly, correctional institutions have supported the deployment of telemedicine. Experience has demonstrated strong evidence of its cost effectiveness in comparison to traditional modes of providing care to inmates.[9] State and federal correction departments are using telemedicine to deliver health care to inmates to improve quality of care, save on transportation costs, and enhance public safety.[10]

ATTRIBUTES OF SUCCESS

To date, there are few systematic attempts to ascertain the attributes of successful telemedicine programs. Despite the diversity of models and the lack of systematic empirical research, practitioners and observers suggest several basic attributes of successful models. These attributes include the following:

- A clearly articulated mission, which provides direction for the program as well as specific targets/goals to be achieved.
- An accountable governance structure, which creates accountability, as well as an effective decision-making authority structure to facilitate operations and coordinate activities within the organization.
- A well-defined service or target population to determine who gets service and on what basis. The criteria for entitlement could be, but are not necessarily limited to, membership in managed care organizations, residents of a specific region, or patients with a particular disease.
- Identification of the service providers, including their specialties, capabilities, and willingness to participate in the program fully.
- Specification of the services provided and the conditions under which the services would be provided. Ideally, the services would match the needs of the target population.
- Administration of quality assurance mechanisms, as well as meaningful ongoing evaluation of activities and outcomes.
- Detailed procedures and protocols for activities ranging from receiving requests and delivering service, to quality control procedures, and outcome evaluations.
- The appropriate choice of technology is also critical to the success of any program, including the appropriate level of investment in technology. Technology must fit the specific clinical needs of the providers as well as the capabilities of the local communities. It must be reliable and responsive, and it must have an open architecture in order to allow changes and growth.
- Finally, programs must be economically viable and self-sustaining, be based on a sound economic framework, which delivers significant value for the investment.

As explained above, these attributes do not derive from systematic research or comparative analysis of operational programs. They are based largely on views of practitioners in the field and general assumptions about organizational behavior. Their derivation seems serendipitous in view of the dearth of self-sustaining models from which such observations can be made. However, with continued information development and proliferation nationally and globally, the technical barriers to network development will continue to decline. Hence, the need to identify sound organizational models and successful attributes will become even greater. Attention is now directed to an attribute long considered essential to the effective and efficient delivery of medical care, namely, regionalization.

REGIONALIZATION

Historically, regionalization has been hailed as an efficient, effective, and equitable basis for organizing and integrating the delivery of health and medical services to a target population residing in a designated geographic region. Both in theory and practice, regionalization is aimed at coordinating and integrating health resources and facilities within regions to promote both efficiency and equity. Efficiency is achieved by means of: (1) locational efficiency of resources, or the optimal location especially of new facilities and (2) efficient utilization of existing resources. Equity is achieved by enhancing access to the available resources by a population living within the specified region.

The lack of implementation of regionalization

in telemedicine networks or planning at the regional level, is likely to result in unnecessary duplication of resources and underutilization/overutilization, or otherwise inefficient utilization of services.[11] However, despite the anticipated benefits, the implementation of regionalization in telemedicine faces serious obstacles related to the difficulties of planning systems in general, especially planning for the coordination and integration of health services in an unstructured environment. To be successful, planning requires political support, citizen participation and detailed information. If not done properly, citizens may not be involved in decision-making; and the planning process may actually lead to increased costs.[12] Moreover, the benefits of regionalization cannot be realized without changes in the resource allocation methods.[13]

With the continued evolution of sound organizational models, telemedicine can offer a fresh new perspective on regionalization that requires serious consideration and attention, since it promises to achieve the desired objectives (1) without having to relocate established facilities, (2) while establishing new facilities at reasonable cost, and (3) causing minimal overall disruption.

The concept of medical care regionalization is not new in the United States, or in many other countries of the world. Considerable efforts have been directed toward organizing medical resources and facilities to improve their geographic redistribution and to overcome disparities in resource availability and people's access to these resources. Today in the United States, major concern is directed toward the differences between rural and urban areas (*Healthy People 2010*).[14] In addition, there is increasing unease at the lack of available and accessible preventative health programs and medical care in large sections of central cities increasingly populated by ethnic minority and poor populations (*Healthy People 2010*). At the global scale, concern is increasingly directed toward the gaps in provision of medical care in developed versus redeveloping and emerging nations.

REGIONAL NETWORKS

Telemedicine networks have the potential to alleviate problems related to geographic isolation and distances that separate patients and health care facilities. Electronic or virtual networks can provide near instantaneous communication links between providers and clients/patients. Indeed, development of comprehensive regional and national networks is key to the substantial reduction in the geographic and time barriers pertaining to medical care availability and access to preventative, therapeutic and health education programs.[15]

Whereas the potential benefits of an integrated regional and national (and international) network for individuals, remote populations, clinical professionals, and health/medical researchers may be obvious, we have yet to realize the necessary and desired seamless, "regionally nested" network hierarchy. Regardless of scale, these networks will not supplant and must be developed and coordinated in conjunction with traditional "in person" medical care systems in situ.

Barriers continue to exist to the development, adoption, implementation, and ultimately the success of telemedicine systems at each level in any proposed regional hierarchy. There are barriers to regionalization at the international level, as well as well as some potential guidelines for development. The following issues were identified by a large sample survey ($n = 350$, from 29 different countries) as general barriers to a "Global Information Society for Health."

- Patient confidentiality and access rights, data protection and security, and consent.
- Clinical risks including quality of practice and malpractice exposure.
- Regulations including reimbursement and licensure.
- Liability for defective telemedical systems and telecommunications network deficiencies.
- Interoperability of work stations, and
- Access to adequate bandwidth.[a,16,17]

SELECTED FINDINGS

There is an extensive literature that describes individual telemedicine initiatives in a variety

[a]It should be noted that the majority of these barriers exist regardless of the scale of the network considered.

of medical and health fields at the regional and national levels. Presented here are few examples to illustrate current findings and provide a basis for further discussion. To date, the most comprehensive effort toward developing a regional (international) hierarchy is concentrated in Europe. Designed for international use, the experiences are both illustrative and instructive for our purposes. For example, under the auspices of the European Union (EU) in cooperation with the G-7/8 countries, a number of regional test beds have been established. Of particular importance is the Global Healthcare Applications Project Theme 8, which aims to demonstrate the potential of telematics in the field of medicine and health care through 10 subprojects covering a wide range of applications and issues. The subprojects ranged from a global public health information network through a global healthcare network with Internet connectivity and concerted international collaboration (www.gip.int/G8/GHAP.htm).

In Europe, the Telematics in Ophthalmology (OPHTEL) project was designed to overcome regional differences in ophthalmology and internal medicine within and between five countries in Europe.[b] The first stage of the project developed a multilingual diagnostic and therapeutic thesaurus in order to create standards for communication and quality control.[18] It was also determined that the scientific quality of transferred ophthalmologic content must be assured.

The Trans European Network for the Provision of Value-Added Services in Telemedicine network project assessed acceptance of telemedical services by end users, the economic viability of telemedicine—especially in an international context, the legal implications of telemedical practice and the regulatory framework within the EU.[19] Results from the study suggested that developing framework agreements between telemedical service providers and "bulk" users, such as insurance companies and public health authorities, would enhance cooperation. Moreover, telecommunications information network "backbones" should be provided over which competing networks could be organized; and, a supranational organization should be organized to operate the international network.

A number of pilot projects have been proposed and undertaken to encourage the growth of telemedicine in underserved regions, including an evaluation of their potential in serving unmet needs and cost-benefit ratios.[20] Such projects could form the basis for developing a national health policy that incorporates telemedicine. At the same time, however, a warning was issued that sponsors of such pilot programs should have a clear plan from the start as to how the project can be sustained when sponsorship terminates.[21] It was also made clear that the rapidly growing interest in telemedicine networks within underserved regions will challenge the medical community and make them reconsider how to provide services and address medical needs in which services are absent or in short supply.[22]

To this end, the EU has sponsored a project in Africa to develop "indigenous" regional telemedicine networks in developing countries connected to European counterparts.[23] For example, the Fundamentals of Modern Telemedicine in Africa (FOMTA) is aimed at preparing the way for the use of broadband technology in Africa. FOMTA was designed to eliminate the lack of a supportive infrastructure by simulating an integrated service digital network. Other pilot projects in Africa and Asia are being carried out under the auspices of the Telecommunication Development Bureau of the International Telecommunications Union.[24]

BARRIERS TO IMPLEMENTATION

The potential of telematics in several areas, including "smart cards," cancer detection, public health information, medical imaging and dentistry has been demonstrated. However, there remain significant barriers to international collaboration and cooperation, including variations in culture, illness behavior, and language as well as incompatibilities in technology, variations in medical practice and requirements for diagnosis and treatment. Other

[b]Denmark, France, Germany, Great Britain, and Italy.

problems in developing and implementing integrated regional projects include:

- Limited volume of utilization to date.
- Lack of clear strategies for promoting wider utilization in particular specialties or geographical areas.
- Lack of uniform standards for health technology assessment.
- Limited dissemination of results based on the experience to date.
- Lack of necessary infrastructure in many remote areas, especially those with greatest needs for medical care and preventative health programs.
- Limited technical resources to assist underserved areas in developing systems.
- Rapid obsolescence of technology and the attendant lack of interoperability.
- Uncertainty about practical and reliable solutions and security of patient data.
- Inconsistent quality assessment.
- Geographic licensure barriers that limit professional privileging across intra- and international boundaries.

A review of the literature that addresses regional and integrated telemedicine network development reveals support for these findings as well as determination of other barriers. The following section describes a few illustrative projects designed to address barriers presented here.

The EU-sponsored Network of Integrated Vertical Medical Services (NIVEMES) was designed to create an international hierarchical network of telemedicine service providers for remote, isolated places for both routine and emergency situations.[25] In conjunction with the project, a variety of new training needs arose. Users had to be instructed in new ways of conducting business, of taking advantage of available services, and even a new way of perceiving health care delivery. In brief, telemedical networks "spawned" in each region had to be coordinated, and the users needed to know where and how to acquire necessary support.

The organizational consequences of regional telemedicine were examined qualitatively among a small cohort of physicians in Norway.[26] Several changes had to be made with regard to the organizational restructuring, patient-flow through the system, job descriptions, and clinical teamwork.[27] Additionally, specific procedures and requirements had to be implemented to ensure the confidentiality and integrity of patient data.

Severe disruption of traditional management and organizational practices was also identified as a derivative of the regionalization of health informatics.[28] Telecommunications and Internet technologies were observed to "render ineffectual" previous external barriers of distance and regional boundaries, while the combination of knowledge bases with information technologies created tendencies towards internal autonomy of organization. From this perspective, telemedicine creates direct and radical challenges to the organizational and national policy control of medical care.

International telemedicine network development also must respect indigenous cultural norms and health care beliefs. Significant questions arise for telemedicine networks, namely, to what extent will international and global telemedicine networks be viewed as a form of "virtual colonialism?" To what extent will and should international and global networks impose a Western model of medicine on culturally distinct populations? What is the price of globalization of telemedicine in terms of loss of diversity? Many national leaders view "global culture as Western culture." The current global information-communication order is seen by some as a principal diffusion agent to serve the market and political needs of the Western world.[29] It is viewed as a form of media or "cultural imperialism" that threatens the cultural integrity of many groups and nations. How can international and global networks avoid imposing a Western medical model and Western philosophy of medicine? Alternatively, perhaps, the question is better framed as, "How can Western medicine be appropriately adapted to indigenous medical cultures and practices through the use of telemedicine?" Acting globally in the Information Society demands cooperation of citizens on a global scale, over different cultures and languages, to an extent not necessary in the past.

The goals and conclusions arrived at in the final report of the G8 Pilot Project Theme 3, Transcultural Education and Training for Language Learning, also addressed this concern.[30] The aim of this project was to develop an international network for language education and training including the cultural dimension required for communicating adequately in another language. Interestingly, one purpose of the project was to help people develop adequate and effective resources to learn better how to communicate—while retaining their cultural and linguistic diversity. Accordingly, this concept of a global information society would give real meaning to citizens. It would enable them to "concretize the vision of technology that supports cultural diversity and richness globally, rather than a uniform monolingual scenario that forces people to adapt to technology instead of technology adapting to people."

RESEARCH AND POLICY CONSIDERATIONS

A review of the literature reveals near universal consensus among scholars, program developers and policy-makers regarding the many issues facing and limiting the full deployment of telemedicine and the exploitation its capabilities regardless of scale, whether regional, national, or international. The burgeoning literature also reveals a plethora of independent, noncoordinated, non-self–sustaining projects at the regional, national, and international scales financed by various combinations of public and private funding. The ultimate success of regional networks remains uncertain, making progress toward a nested hierarchy of regional programs leading to a truly national and ultimately international network all the more demanding. Nonetheless, effective, integrated virtual and traditional regional networks must be developed, deployed and maintained at the regional, national and international levels.

Several questions and issues must be addressed and resolved before an integrated, seamless, nested telemedicine hierarchical network can be realized. Some of these issues are complex and difficult to solve, and some may be addressed in several different ways. However, it is important to start the process without delay.

RECOMMENDATIONS

The development of national and international regionally integrated networks requires an effective and efficient organizational structure to develop guidelines, regulations, licensing procedures, as well as security and privacy protection for patients and providers. The World Health Organization (WHO) is ideally suited for these tasks. Its regional offices could serve as a starting point for the development of a global telemedicine union. The WHO also has official relationships with the United Nations, the European Union, Organization for African Unity, as well as over 150 additional regional, national, and international nongovernmental organizations (NGOs) from the Aga Khan Foundation to the World Veterinary Association. The WHO has also made a commitment to use telecommunications for health and to partner with the United Nations and other organizations to advance the exchange of health information across geographic, temporal, and social boundaries.[31]

The European Union provides another model for this type of international cooperation within one region of the world. Although a supranational organization, it operates in a coordinated manner in the political, economic and medical sectors for (currently) 15 countries.

The development of subnational regional and interregional telemedicine organizations requires close cooperation and coordination among the constituent telemedicine programs. Each region would be self-contained in terms of providing a complete range of primary care and specialty services within its network of providers.

The potential for developing integrated telemedicine/telehealth networks at the regional, national, and international scales depends largely on the existence of an adequate telecommunications infrastructure. Overcoming the "digital divide" that separates areas with and without adequate communications

infrastructures will be expensive, but it must be identified as a national and international priority. Regional and national virtual/electronic communication networks must be developed and maintained in order to improve access to quality medical care for people living in medically underserved areas. The new information network will create a new geography of medical care, while retaining some traditional elements of the old system.

Within the United States as well as within and between most countries, there remain many and deep cultural (religious, linguistic, ethnic), socioeconomic, and historically diverse communities. These differences are reflected in the evaluation, interpretation, and treatment of diseases and health conditions and are manifest as barriers to development of a national standard for medical terminology and treatment protocols. The variability of medical/heath resources including technology and personnel also constitutes a formidable barrier to a seamless hierarchy of telemedicine/telehealth networks. Serious and concerted action must be directed at reducing the "digital disparities" between communities, regions, and nations.

While many networks and models are recognized as "successful," little research addresses the measurable and relevant outcomes of successful models beyond anecdotal and subjective evaluations of pilot projects. The key attributes of successful models and the fatal flaws of unsuccessful models merit increased emphasis and study. Consideration should also be given to determine whether smaller, successful models could be scaled to larger populations and regions.

Telemedicine networks cannot be developed entirely separate from the traditional health care networks already in place. There must be coordination and integration between the telemedicine and traditional medical care networks if the entire process is to be successful. Remote expert diagnosis, clinical protocol, and prescription do not help patients in areas lacking appropriately trained personnel and without access to appropriate medical facilities. Telemedicine networks cannot be planned and implemented without taking into consideration the "facts" on the ground. For the foreseeable future of telemedicine, the geography of remote populations, travel distance, and the distribution of remote personnel and facilities will remain fundamental to planning of regional networks, regardless of scale.

In certain areas, for example, teleradiology and telepathology, international standards and terminology have been developed. It is not as simple, however, when clinical diagnosis and treatment are involved. Further study is needed in the development of clinical guidelines for other specialties. This will allow networks to share resources across models more effectively.

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