

Investigating Telemedicine Developments in Taiwan: Implications for Telemedicine Program Management

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Abstract

Telemedicine development in Taiwan has proliferated considerably since the 1990s, as manifested by its inclusion as a core application area in the National Infrastructure Initiative and other national initiatives. Judged by service volume and sustainability, all existing programs are largely in an experimental stage. The desired transition or advancement to real-world clinical settings requires a host organization's addressing important program management challenges. The current research investigated telemedicine development in Taiwan and analyzed the services provided by representative programs. Based on our analysis results, we discuss important implications for program management that are critical to the ultimate success of telemedicine in a healthcare organization.

1. Introduction

Telemedicine development in Taiwan has proliferated considerably since the 1990s, as manifested by its inclusion as a core application area in the National Infrastructure Initiative (NII) launched in 1995. This technology-enabled alternative mode which allows service delivery and collaboration beyond geographic and temporal barriers has also been identified as a critical application in other similar initiatives, including National Broadband Experimental Network. Critical to the rapid development of telemedicine is government participation, particularly on the part of the Department of Health, Taiwan's supreme health policy maker and principal healthcare system architect. According to the Department of Health, the overarching goal of telemedicine in NII is to design, establish and evaluate a wide array of services that jointly constitute a nation-wide pilot system for remote diagnosis and patient management.

Central to telemedicine implementation and evaluation is proactive participation by leading acute tertiary care centers and teaching hospitals that include National Taiwan University Hospital (NTUH) and Taipei Veterans' General Hospital (TVGH), both of which joined the NII telemedicine scheme at its launching. Since

then, other hospitals have entered the national telemedicine map charted by the Department of Health, including Taipei Military General Hospital (TMGH). These programs were initially driven by their desire for service access and care quality enhancement, primarily through vertical service integration that connects care providers in primary, second and tertiary sectors. Gradually, additional services or activities have been incorporated in these programs, including support for clinical training and continuing education.

Judged by service volume and sustainability, existing programs are largely in an experimental stage. At the time of investigation, most programs, in spite of adequate technology bases and routine service delivery, greatly depended on external resources and voluntary participation of individual physicians/specialists, technologists and/or researchers for operations and services. Collectively, these programs have demonstrated the clinical value and technical feasibility of telemedicine-based patient care and service collaboration. However, the transition or advancement from the current experimental environment to real-world clinical settings requires the host organization's addressing important program management challenges. As concluded by Perednia and Allan [1], the ultimate success of a telemedicine program demands an organization to address challenges in both technology and management. The current research investigated the telemedicine development in Taiwan and discussed its program management implications, based on our analysis results.

The organization of the remaining paper is as follows. Section 2 reviews the overall telemedicine developments in Taiwan, followed by a survey of the representative programs in Section 3. Section 4 analyzes the services provided by these programs, including utilization, distribution, and physicians' evaluation and concerns. Section 5 discusses important program management implications derived from our findings. The paper concludes with a summary, discussion of its contributions and some future research directions in Section 6.

2. Telemedicine developments in Taiwan

In this study, telemedicine broadly refers to the use of information technology to support remote patient care/management or distributed service collaboration through electronic transmission of essential information and expertise among geographically dispersed parties who include patients, general practitioners and specialists [2-4]. In 1995, the Department of Health released the first national telemedicine bluebook in Taiwan, highlighting the use of adequate and available technologies to enhance service accessibility, quality, timeliness and cost effectiveness. Both horizontal service extensions to remote areas and vertical care integration seamlessly connecting care providers in the primary, secondary and tertiary sectors were identified as important clinical applications of telemedicine whose support for non-clinical services or activities was also emphasized.

Partially funded by NII, the Department of Health provided most programs with financial assistance in technology acquisition. Technologies supporting synchronous and asynchronous services were targeted. Videoconferencing systems with multimedia capability were common to synchronous services, including

real-time patient assessments, diagnostic services, and consultations. On the other hand, medical imaging transmission and display systems and electronic patient record systems are common to asynchronous services or consultations. A review of the services rendered suggested that diagnostic/prognostic services and consultation involving intensive use of medical images prevailed in most programs, particularly those related to neurology, dermatology and internal medicine.

Figure 1 depicts the major telemedicine programs in Taiwan. As shown, most programs were located in Taipei, with the exception of the program housed at National Cheng-Kung University Hospital. All of the existing programs shared a common emphasis - enhanced patient care and management through vertical service integration. Typically, a program was housed at and managed by an acute tertiary or teaching hospital that had a direct linkage to a primary or secondary care facility (e.g., clinic or regional general hospital). The usual service arrangement was point-to-point and therefore failed to create a service network or community. All existing programs exhibited a predominant focus on clinical services, even though other services or activities were also supported.

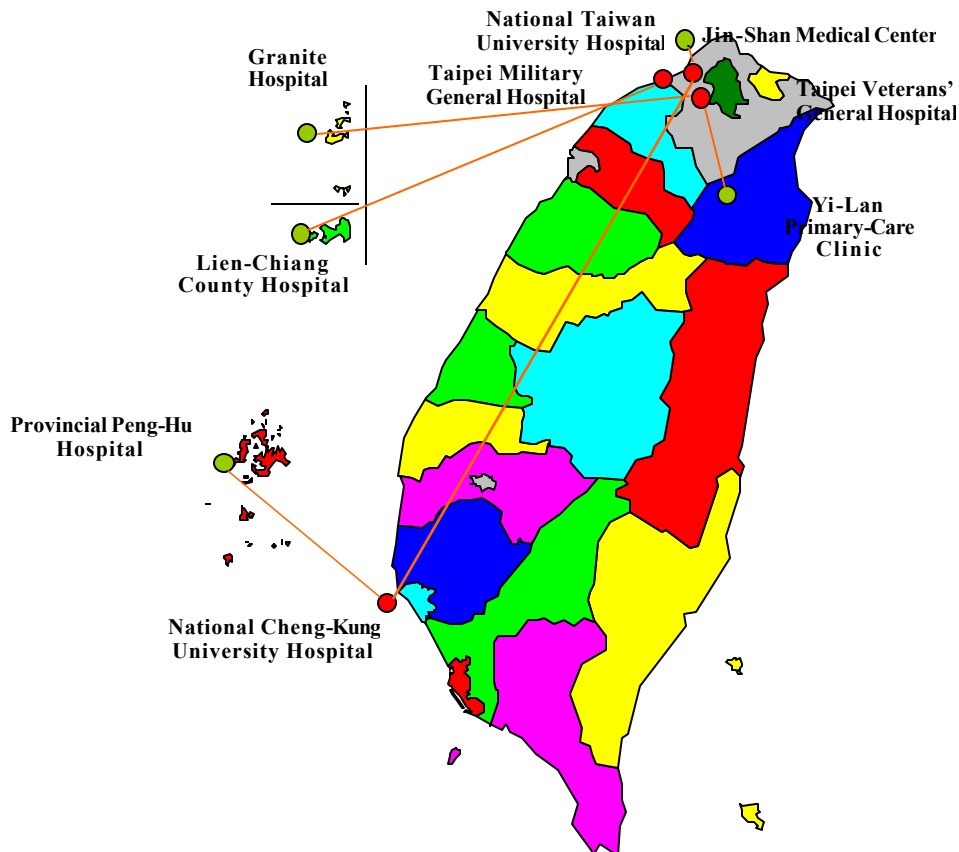


Figure 1. Major telemedicine programs in Taiwan

The cost of providing a telemedicine service was reimbursable within the National Health Insurance Scheme¹ as well as by the National Infrastructure Initiative. Specifically, payment for services of on-site attending care providers was reimbursable by the National Health Insurance Scheme, while the services of a remote acute tertiary or teaching hospital were reimbursed by the National Infrastructure Initiative. Connection services were available free of charge, provided by Bureau of Telecommunications, Taiwan's largest telecommunications service provider that is primarily owned and controlled by the Ministry of Transportation. Depending on the particular requirements, different connection services were available, including an integrated digital network (ISDN) and a high-speed digital exchange network that supports frame relay and asynchronous transfer mode (ATM) transmissions.

3. Survey of representative programs

National Taiwan University Hospital (NTUH)

Officially launched in 1995, this program connected NTUH and the Jin-Shan Medical Center, a primary-care clinic located in rural Taipei County. Using a state-of-the-art videoconferencing system together with a medical imaging transmission and display system and a multimedia patient record retrieval system, NTUH provided both synchronous and asynchronous services to patients located in the connected medical center. Services commonly offered included patient assessment, remote diagnosis, and diagnostic or therapeutic consultation services, across a wide array of specialty areas. In 1997, NTUH expanded its telemedicine program by directly connecting with National Cheng-Kung University Hospital, the most important telemedicine center in southern Taiwan. Connecting two major telemedicine centers, this direct linkage allowed peer-to-peer consultation, collaborative patient management or clinical case discussion between or among specialists located at different tertiary hospitals. In addition, this linkage also served as an important backbone to the nation-wide telemedicine service network envisioned by the Department of Health. Via this direct connection, a considerable number of peer-to-peer consultation and teaching case discussion sessions took place, involving specialists at both hospitals. Figure 2 depicts the system architecture of the NTUH telemedicine program.

Taipei Veterans' General Hospital (TVGH)

Taipei Veterans' General Hospital is a modern acute tertiary hospital which serves both the military

community and the general public. TVGH joined the NII telemedicine scheme in 1995, operating a direct service link to Granite Hospital, the largest military hospital on off-shore Jin-Men island. Using the same designated ATM-T1 line, TVGH also offered telemedicine services to patients from Jin-Men Provincial General Hospital. The telemedicine suite was located in Granite Hospital, to which patients from the provincial hospital had to travel. By design, the program was to integrate its telemedicine technologies, including a videoconference system and a medical image transmission and display system, and the existing patient information systems and imaging archive database systems housed at TVGH. Service-wide, TVGH offered around-the-clock diagnostic and therapeutic consultation services to patients located at both connected off-shore hospitals, especially to those in need of urgent care. In 1997, TVGH operated the second service link, connecting to a public primary-care clinic in Yi-Lan County (in eastern Taiwan). The services available via the second link were mostly similar to those for patients located in the off-shore hospitals. At the time of study, TVGH was the only telemedicine center that offered services to multiple remote facilities. Figure 3 depicts the system architecture of TVGH telemedicine program.

National Cheng-Kung University Hospital (NCKUH)

National Cheng-Kung University Hospital was the only tertiary teaching hospital that joined the NII telemedicine scheme at its launching, operating a direct service link to Peng-Hu Provincial Hospital, a general hospital located on the off-shore Peng-Hu island. Consultation and diagnosis support of emergency care were primary services of the program, supported by a high-resolution image transmission and display system and a videoconferencing system. In addition, the program also provided scheduled virtual (outpatient) clinic sessions to patients not in need of urgent care as well as clinical case discussion and various continuing education programs for healthcare professionals. Judged by the service volume and activities supported, this program arguably was the most active telemedicine program in Taiwan, offering 625 telemedicine (clinical) sessions and delivering distance continuing education to 534 individuals in 2000.

¹ Underwritten by Health Insurance Bureau, National Health Insurance Scheme is a safety net provided by the government to all citizens in Taiwan.

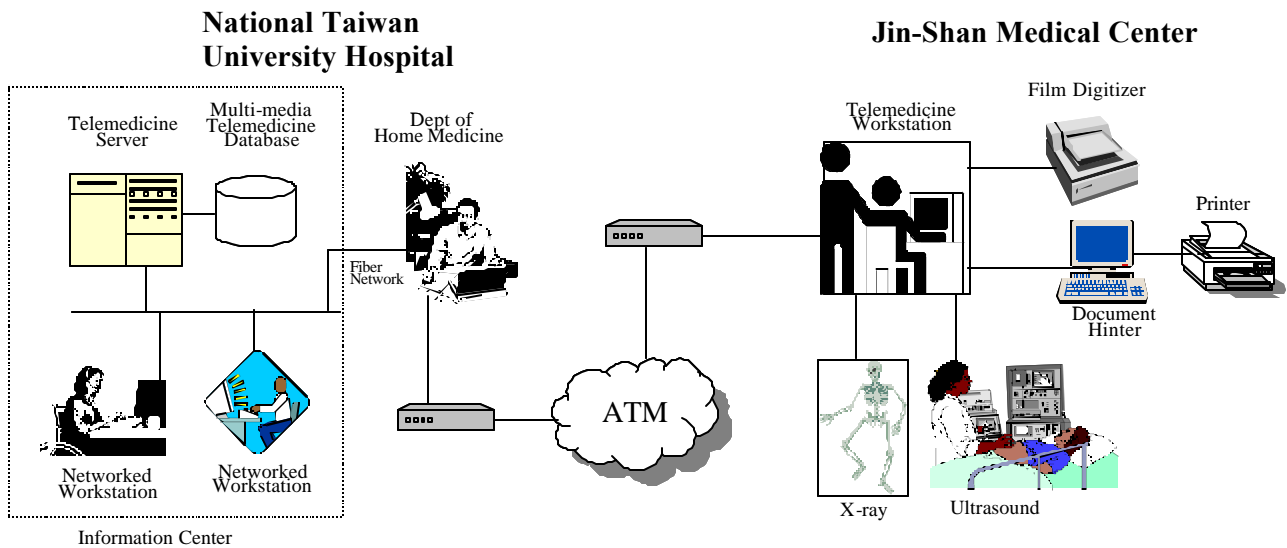


Figure 2: System architecture - National Taiwan University Hospital

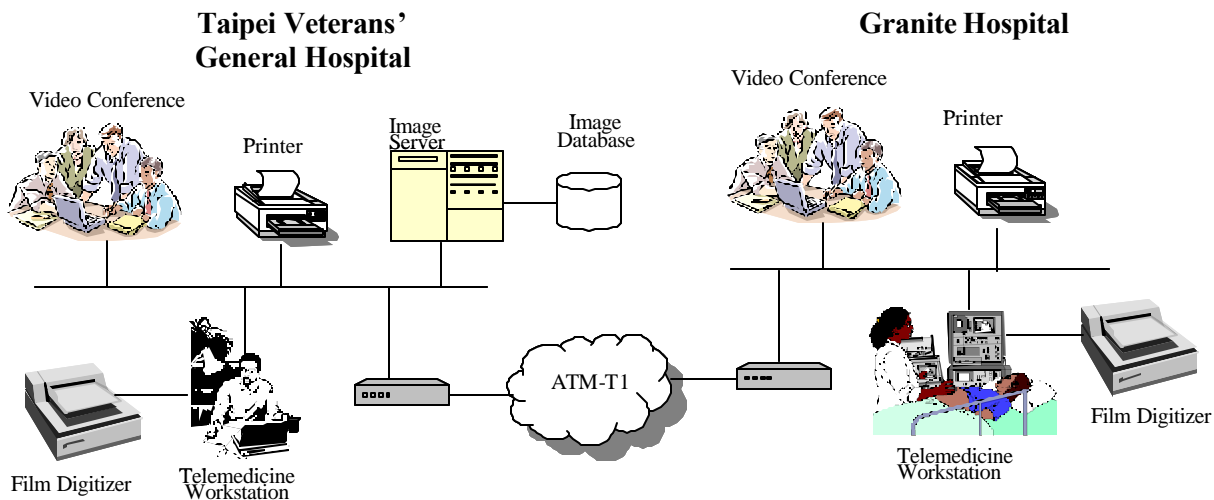


Figure 3: System architecture – Taipei Veterans' General Hospital

Taipei Military General Hospital (TMGH)

Taipei Military General Hospital provides acute tertiary care to the military community. TMGH joined the NII telemedicine scheme in 1997, operating a direct ISDN line that connects to Lien-Chiang County Hospital on the off-shore Ma-Tsu island. The program was supported by a mid-range videoconferencing system and a medical image transmission and display system. At the time of the investigation, actual service utilization was limited; most was pertinent to urgent patient care.

A review of these representative programs suggested several characteristics of telemedicine development in Taiwan. First, overall program planning was centralized.

While its initiation may have proceeded independently in the host hospital, each program eventually involved the Department of Health, particularly in program assessment and coordination. The Department of Health actually served as a centralized program planner, charting individual service links and their integration into a nationwide service network revealed in its telemedicine bluebook. Second, program autonomy was high. Upon completing a connection (hospital) choice, a program was highly autonomous with respect to specific services to offer and specialty areas to include. Third, each program had a fairly sophisticated technology base with which its telemedicine technology was integrated to varying

degrees. Typically, a program acquired telemedicine technologies from external vendors but technology transfer, testing, evaluation, enhancement and integration were mostly undertaken by in-house technologists and affiliated research groups, especially in teaching hospitals.

Service-wise, most programs concentrated on patients located in rural or off-shore areas and exhibited a predominant focus on vertical service integration by connecting care providers in primary, secondary and tertiary care sectors. The target service recipients and service focus were largely consistent with those commonly found in the U.S.-based programs but distinctly differed from those of urban-based programs in Hong Kong [5-6]. Service financing was also worth discussing. By and large, telemedicine services were reimbursable within National Health Insurance Scheme as well as by the National Infrastructure Initiative, making them more economically viable than those completely depending on voluntary participation from care providers. Operating costs including technology maintenance and connection services (currently provided by external entities) were not accounted by the current payment model. At the time of the study, the participating healthcare organizations at either end of a telemedicine link were reluctant to pay for connection services. These and other operating costs had significant implications for program success and sustainability and thus needed to be properly factored into the payment structure.

4. Analysis of services by programs examined

In this section, we analyze the services provided by the programs surveyed, including utilization, distribution, and physicians' evaluation and concerns.

4.1 Service utilization

The service volume of each program had been increasing at a steady pace but had not yet reached a significant level. NCKUH probably was the most active telemedicine service provider and offered a total of 625 sessions in 2000, showing an approximate 300% increase in service volume since 1996. Similar stable growth was also observed in other programs. For instance, TVGH provided a total of 183 telemedicine sessions in 2000, representing a 200% growth in service volume since 1997. On the average, all programs offered approximately 1.5 sessions a day. Most services were for remote diagnosis or diagnostic/therapeutic consultation. A typical telemedicine session was 30 minutes in length (not including scheduling and data transmission) and, on average, involved 1.2 physicians and/or specialists. In most cases, the patient remained under the care of the on-site attending care provider (at the connected hospital or clinic) after a telemedicine session. In some cases,

patient transfer to the host or a nearby tertiary care center was arranged immediately after the session.

4.2 Service distribution

Analysis of the services provided by the programs suggested a prominent focus on real-time synchronous patient assessment or diagnosis between the patient and a remote specialist, with or without the participation of an on-site attending physician. For instance, all of the telemedicine sessions offered by NCKUH in 1996 were for real-time diagnosis or diagnostic/therapeutic consultation through which the patient was directly diagnosed or examined by a remote specialist. The dominance of real-time diagnosis and diagnostic/therapeutic consultation later appeared to have declined but still accounted for a vast majority of the services rendered by NCKUH; i.e., at least 70%. A similar service concentration was also observed in other programs, including those provided by TVGH to patients at Granite Hospital and Yi-Lan Medical Center.

Also observed was a trend toward increased service diversity, as measured by information or data specificity, medical specialty and service nature. A review of the particular information or data transmitted in a telemedicine session showed a dominance of medical images (e.g., X-ray and CT scan images) in the initial stage of each program. Among the 174 sessions provided by NCKUH in 1996, 168 involved the use of X-ray images and 78 involved CT scan images. Over time, additional information or data types have been incorporated in the telemedicine sessions, including laboratory reports, pathology reports, patient clinical histories, vital sign records, ultrasound, EKG, and others. Diversity in medical specialty area also prevailed. The initial services provided by each program typically centered around a handful of specialty areas, including neurology, dermatology, neurosurgery, internal medicine (chest), and cardiovascular medicine. Inclusion of services related to other specialty areas gradually took place as a program grew. In addition, diversity in service nature was also recorded. Most programs began with a prominent clinical focus and then started experimenting the use of telemedicine technology for supporting other services and activities that included teaching case discussion and continuing education. For instance, NCKUH used telemedicine technology to offer a considerable number of distance continuing education from the program's commencement. A review of all the programs surveyed suggested a stable growth in training or education applications, which were likely to proliferate with direct linkages connecting different telemedicine centers; e.g., the direct connection between NTUH and NCKUH.

4.3 Physicians' evaluation and concerns

Based on responses from physicians or specialists directly participating in telemedicine services, the overall value of telemedicine was widely recognized. As a group, these physicians and specialists found telemedicine appropriate or effective for remote patient assessment and diagnosis, virtual diagnostic consultation or therapeutic coaching, distant patient monitoring, distributed team-based patient management, and second opinion solicitation or case discussion. However, the service enhancements experienced or perceived were accompanied by concerns. For instance, many physicians voiced their concerns about telemedicine's potential adverse effect on their professional authority and autonomy. Synchronous collaborative diagnosis or consultation inevitably required real-time decision-making on the part of participating physicians or specialists, who understandably might not agree in their judgment or opinions. From a patient perspective, such differences or incompatibility, when inadequately managed, could jeopardize the professional authority of an individual physician or specialist. Autonomy was another area of concern. Use of telemedicine greatly facilitated solicitation of second opinions from peers or consultation with specialists. Typically, a synchronous session connected the patient, the on-site attending physician, and a remote (consultant) specialist in a real-time manner. The interaction pattern and dynamics among the participants might adversely affect the autonomy of a care provider, especially the attending physician located at the connected clinic or hospital.

A considerable number of physicians and specialists also expressed concerns about maintaining the necessary physician-patient relationships in a telemedicine setting. In a conventional setting, relationships are established and strengthened through direct face-to-face interactions between the physician and the patient, including non-verbal expressions and eye contacts. Interacting with a patient in a virtual setting, a physician might have difficulty establishing and cultivating the relationships important to obtain the patient's trust and subsequent collaboration.

In addition, some physicians and specialists had concerns about the actual service delivery. For instance, reading a radiological image in a digital setting might considerably differ from reading conventional analog films. Maintaining the service quality and consistency at an acceptable level may require considerable learning on the part of physicians or specialists. Learning to "see and feel" patients in a virtual setting or communicate with them remotely can be challenging. In a typical telemedicine session, the physician or specialist might have difficulty collecting important non-verbal expressions or cues easily detectable in conventional face-to-face service encounters.

Patient privacy was another source of concerns to many physicians and specialists, who argued that the host organization needs to implement adequate safeguards or mechanisms for preserving the necessary patient information confidentiality at both connection ends. When participating in a telemedicine session, a remote consultant or specialist has access to and, in effect, obtains a copy of the transmitted information or data concerning the patient. Thus, policies, procedures and mechanisms must be defined and established to govern the use and re-distribution of the transmitted information. Furthermore, several physicians also concerned the primitive integration between telemedicine technology and the concerning in-house information systems as well as the potential problems in integrating telemedicine systems across different platforms or standards.

Looking beyond the experimental stage, most physicians and specialists agreed that the ultimate success of telemedicine as a viable service delivery alternative requires that crucial contextual issues (e.g., legal liability and service payment) be properly addressed. First, the legal liability of each service participant or provider needed to be explicitly defined. A reasonable starting point may be analyzing and delineating the particular role of each provider in a telemedicine session. Service payment or reimbursement was also identified by physicians and specialists to be important to program sustainability. At a minimum, a feasible payment structure needed to take into account the services of all participating care providers, technology costs (including use, maintenance and depreciation) and the necessary peripheral services (e.g., connection services).

5. Implications for telemedicine program management

Findings from our analysis reveal several implications for program management. First, providing routine services using telemedicine technology may require considerable learning or training on the part of physicians and specialists. User training is important, as commented by Klienke [7] that physician resistance is an important bottleneck to the adoption and diffusion of technology innovations in health care. However, training should not be confined to technology use and operations but, when appropriate, should include verbal communication and detecting/obtaining important non-verbal expressions or cues in a virtual setting.

Preserving professional authority and autonomy in telemedicine services also is important. Davidson and Chismar [8-9] examined technology adoption in hospitals and suggested that potential invasion of professional authority was an important factor in physicians' reluctance or resistance to use of technology. Explicit delineation of the role of each service participant or

provider is an essential first step toward preserving professional autonomy of individual professionals. Designing and implementing an adequate service or communication protocol also contributes to the discussed professional authority and autonomy preservation.

Technology management represents another important management issue, commencing rather than punctuating with technology acquisition. Both system integration and interoperability are relevant. First, integrating telemedicine technology with the relevant in-house systems is essential. Regardless of its nature and intended recipient, a telemedicine service usually involves information (or data) from multiple sources whose integration with the underlying telemedicine technology is therefore important. System interoperability across different platforms or vendors is critical and its importance significantly increases when scaling services from a point-to-point configuration to a networked setting where heterogeneous technologies are used by different participating organizations. Acquiring technologies that share common standards is essential to interoperability in situations where service participants use technologies from different vendors. For instance, a medical image system whose storage format follows a Digital Imaging and Communications in Medicine (DICOM) standard is desirable. Similarly, transmission of medical images between (or among) service participants can be greatly supported when both (or all) connecting organizations have implemented Picture Archiving Communications Systems. The cross-platform system interoperability described is also required for patient information confidentiality and needs to be preserved at both algorithms (e.g., encryption software) or a particular communication layer (e.g., Secure Socket Layer).

Service configuration is also important. Telemedicine is network-based and its services may encompass considerable network externalities. That is, the value of a telemedicine service may be perceived to be higher when it includes more participants, patients or care providers. Hence, expanding telemedicine services beyond the common point-to-point configuration into a networked community is desirable, especially when connecting a network of service providers (e.g., physicians and specialists) with a network of service consumers (the general public). An expanded service configuration is also economically appealing, because of economy of scale and probably economy of scope.

In addition, service diversity is also critical to the success of a telemedicine program. An organization may choose to concentrate its telemedicine technology use on clinical services but should not exclude alternative applications. Basic clinical training and continuing education are common non-clinical activities that may be better supported in a telemedicine setting. Diversity in medical specialty area is also desired. Telemedicine is an alternative service delivery mode potentially applicable to

services pertinent to different specialty areas. These services may differ considerably in their respective requirements but their inclusion in a telemedicine program understandingly contributes to the program's overall value and likelihood of success.

6. Conclusion

In this study, we examined the overall telemedicine development in Taiwan and analyzed representative programs. Based on our analysis results, we discussed several implications for program management. Overall, our findings suggest that physicians and specialists in general recognized the clinical value and technical feasibility of telemedicine but had concerns about its potential invasion of their professional authority or autonomy. In addition, concerns were also raised in several areas, including service delivery, physician-patient relationships, system integration and inter-operability, legal liability and payment for services.

The current study has contributed to telemedicine research. Specifically, we surveyed the overall telemedicine development in Taiwan, analyzed the services provided by several key programs, and identified concerns of physicians and specialists with respect to telemedicine services. In turn, these concerns represent issues critical to the success of a telemedicine program. At the same time, the study also contributed to telemedicine practice. Based on findings from our analysis, we have discussed important implications for program management. Understanding these implications, an organization is likely to be able to improve the management of its telemedicine program.

Several directions deserve future research attention. For instance, developing a systematic framework explaining and therefore predicting the effectiveness of telemedicine program management is important. Both the process and the factor approach may be appropriate and together they can provide a fuller depiction of the program management under examination. Managing each identified concern is also essential and may have significant implications for telemedicine research and practice. In addition, examining the management practice of each program under investigation is also interesting and can generate results of a finer granularity and thus more actionable.

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