Geographical Characteristics of Telemedicine in Korea and Japan

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Received June 22, 2009; Accepted June 14, 2010

Abstract Assessments of telemedicine from a geographical perspective have generated a variety of opinions with regard to its distribution and optimal spatial organization. Such discussions are associated with the fundamental question of health care, in other words, the balance between equity and efficiency in health care services. Accordingly, these discussions are concerned with the extent to how telemedicine can complement insufficient medical services (equity) and how telemedicine plays a role in making a profit for patients or medical institutions (efficiency). Within such contexts, it is stipulated that telemedicine in Korea and Japan aims to promote regional health care and has emerged on basis for each diagnostic area controlled at a tertiary-care level. In spite of its significance and the rise of informatization in health care, few have attempted to address telemedicine in geography. Therefore, this paper presents arguments on the geographical characteristics related to two aspects of telemedicine—distribution and network—in Korea and Japan and explores each telemedicine operation through two cases. For the most part, the medical institutions involved with telemedicine in Korea are distributed in Kyunggi (the central part of Korea as the metropolitan area). As for Japanese telemedicine, the medical institutions supplying and receiving telemedicine are mainly located in the northern and southern parts of Japan, but not in metropolitan areas. Regarding telemedicine networks, the nationwide medical institutions receiving telemedicine are considerably involved with the medical institutions providing telemedicine in Kyunggi. Contrary to the Korean case, the Japanese telemedicine networks are based in each diagnostic area and are controlled at a tertiary care level. Moreover, some of the outlying Japanese telemedicine networks lack strong referral relationships with metropolitan areas, unlike those in Korea. Therefore, it is not an oversimplification to say that the geographic characteristics of telemedicine in Korea and Japan can be summarized as “centralized” and “decentralized,” respectively. The differences in their traditional health care systems and development processes and the distinctions regarding how telemedicine is used as well as the knowledge of patients and medical workers all have a significant effect on such geographical characteristics. Accordingly, the geographical phenomena of telemedicine are influenced not only by technological aspects but also social and medical circumstances.

Key words telemedicine, distribution, network, centralization, decentralization, Korea, Japan

Introduction

Telemedicine utilizes information and telecommunication technologies to transfer medical information for diagnosis, therapy and education (Norris 2002). In general, it enables doctors to provide professional advice to low-level health facilities and to share the patient’s medical records among medical institutions (Shannon 1997; Norris 2002; Lucas 2008; American Telemedicine Association 2009). Medical institutions providing telemedicine (as the telemedicine supplier), medical institutions receiving telemedicine (as the telemedicine customer) and the intermediate technologies compose the telemedicine system. Occasionally, administrative aspects, serving as gatekeepers, and business aspects, which manage or control the telemedicine system, are involved in its function as major stakeholders.

In general, health care or medical services are faced with how to provide services to the public fairly (equity) and how to make a profit for medical institutions (efficiency) (Smith 1977; DeVerteuil 2000). Within such contexts, assessments of telemedicine can be divided into two aspects: distribution and network characteristics. Discussions on the former focus on the fact that telemedicine at its earliest stages was regarded as an innovative medical technology for rural and isolated communities that suffered from geographical and economic problems, which prevented the delivery of proper medical services (Reid 1996; Capalbo and Heggem 1999; Mihara 2004). With the rapid development of telecommunication infrastructure and related technologies in the 21st century, contemporary telemedicine is available everywhere—in the regional health care system and in urban areas as well. Therefore, the matter of restricted distribution has gradually faded out of discussions involving telemedicine.

Regarding the latter aspect of telemedicine, there
have been many debates focusing on geographical size, population, specialty, disease and open or closed systems, as they relate to a specific client population (Abou-Shaaba and Niazy 1991; Cutchin 2002; Glasgow 2002; Shannon et al. 2002; Gilbert et al. 2008). Among those debates, regionalization is regarded as the best method for optimal spatial organization (Cutchin 2002; Shannon et al. 2002). In terms of health care, regionalization means that authority for performing health care functions is transferred to a specialized local office or to local organizations within well-defined geographical boundaries (Milles et al. 1990); this same definition is applied in telemedicine. Telemedicine is associated with cyberspace and therefore not influenced by physical restrictions or affected by geographical considerations. Accordingly, regionalization may seem unimportant in a discussion about telemedicine. In practice, the latter factors have led many countries to stipulate that patients must see medical specialists in person at least once to avoid an incorrect diagnosis when using the telemedicine system: limitations of the current telemedicine technologies; insufficient verification of the safety of telemedicine (Tanriverdi and Iacono 1999; Norris 2002; WHO n.d.); and the characteristics of health care itself that are strongly associated with tactile communication and sharing via face-to-face interaction between medical specialists and patients (Andrews and Kitchin 2005). For these reasons, the issues of accessibility to, and utilization of, medical institutions are considerably important in telemedicine. Also, it is not currently possible for telemedicine to completely substitute for traditional “hands-on” health care in practice. Moreover, as the telemedicine system develops, the regional-based telemedicine system that is based on a patients’ living space should emphasize obtaining data to control and maintain proper medical services toward the public (Braa and Hedberg 2002; Solomon 2007; Mänpää et al. 2009). Most importantly, even though telemedicine is operated in a virtual space, derivative profits (medical incomes) are directly associated with the offline health care system. Therefore, if medical incomes are confined to one diagnostic area, it may lead to the breakdown of other diagnostic areas and may threaten the maintenance of medical facilities. As a result, telemedicine has become associated with regionalization to improve access, quality, cost and equity of treatment (Cutchin 2002); it has also focused on how to ensure specialized care at both the telemedicine supply side and the telemedicine custom side (i.e., telemedicine networks) as a complementary device of health care.

Within such contexts, telemedicine practices in Korea and Japan are based on the medical laws and developmental processes in their respective countries. In other words, telemedicine can be identified with the promotion of regional health care (including urban areas) and its operations are carried out within each diagnostic area in relation to the regional health care delivery system at a tertiary-care level. However, these arguments have not yet been discussed or tested empirically in Korea or Japan. This paper attempts to provide the geographical characteristics of telemedicine by using Korean and Japanese telemedicine data; additionally, it will examine each telemedicine operation through two cases, Choongbook in Korea and Nagano in Japan.

Background

In the case of Korea, the modern health care system was developed in 1989 after simultaneous changes to the laws of the medical insurance system and the health care delivery system (Ministry of Health and Welfare in Korea 1996; Lee and Kim 1997; Yoon 1997). The goals of these laws were to prevent an overwhelming number of patients at general hospitals, stabilize public health finances and develop health services in a balanced manner throughout the country. From a geographical point of view, the Korean health care system is based on 8 diagnostic areas according to population size and living space and medical institutions are classified as primary, secondary or tertiary care levels in each diagnostic area.

The current Japanese health care system traces its origins back to 1961, when the health insurance system was introduced on a national scale (Tatara and Okamoto 2009). According to the legislation related to the health care system, it was designated to promote the planning of health services for residents in each diagnostic area. In addition, it is closely connected with local governments and each of the 47 prefectures established health care system policies with respect to their own social and economic circumstances. In common, the Korean and Japanese health care systems follow a regional-based diagnostic system and their health care policies aim to promote regional health care.

Within such a context, the early Korean and Japanese telemedicine experiments focused on providing health care to rural and isolated communities by connecting innovative telemedicine centers with areas that received insufficient care. The beginning of telemedicine in Korea was the result of an experiment by Seoul National University Hospital and Yeoncheon Health
Center in the late 1980s; it was gradually adopted by medical communities in the late 1990s, when medical information systems such as PARC (Picture Archiving and Communication System) and OCS (Order Communications System) were utilized by many medical institutions involved with general hospitals (as medical institutions for tertiary care). Currently, the medical laws related to telemedicine only permit doctors to provide medical information and offer the support of medical technologies. As mentioned before, these same laws stipulate that patients must see medical specialists in person at least once to avoid an incorrect diagnosis through the use of telemedicine alone (due to safety concerns).

Even though the history of telemedicine is not very long, major telemedicine types are tele-education on the web, telemonitoring and teleconsultation (Park 2004); the online referral system is managed by many medical institutions and allows the sharing of patients’ medical records among medical institutions (Figure 1). With the online referral system on the web, doctors are provided with medical records (e.g., images, live video and audio) and can diagnose their patients more easily. Already, the online referral system has been established as a major telemedicine method in Korea and the health care system depends on electronic transmission of these records in most cases. Nationally, there are the 62 medical institutions that participate in the online referral system and they are mainly general hospitals that provide tertiary care. Regrettably, the online referral system does not mean open networks among medical institutions on a nationwide scale. In other words, the telemedicine supply part of each of the 62 medical institutions serving the online referral system is managed independently and only medical institutions providing or receiving telemedical services can use the system.

In Japan, the first application of telemedicine was a remote diagnosis conducted in 1971 (Telemedicine Report 1997). It was performed by the Medical Association of Wakayama with the cooperation of Wakayama Medical College and Osaka University (Takahashi 2001). For a long time, telemedicine in Japan was at a standstill; however, telemedicine has rapidly spread throughout the country more recently because of the dramatic expansion of broadband networks after 1997 and because of the Medical Act by the Japanese Ministry of Health, Labor and Welfare (Hasegawa and Murase 2007). The unique aspect of the Japanese system is that many telemedicine operations are supported by the central government, but they are operated by various groups: local governments, medical institutions (which took charge as telemedicine suppliers) and other operators (companies or universities). The government and other major players in the telemedicine industry regularly meet to help influence and establish laws that will result in a stable system (Hara 2009). Like Korean telemedicine, Japanese telemedicine only permits information exchanges among doctors or medical specialists by law.

Generally, telemedicine in Japan is divided into three types: teleradiology, telepathology and home telecare (An 2005; Hasegawa and Murase 2007). Due to decreases in the number of medical institutions and medical specialists in pathology and radiology (particularly in local areas), the telemedicine systems related to teleradiology and telepathology are regarded as major countermeasures to combat this shortage (Hasegawa and Murase 2007) (Figure 2). Recently, telemedicine service companies have attracted attention and they are providing online

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Figure 1. The composition of the online referral system in Korea.
left–medical records and right– images.
Source: Marotech.
Telemedicine occupies an important position in the regional health care systems of Korea and Japan, including in urban areas. Its operations are carried out within each diagnostic area and controlled at the tertiary care level; there are 8 diagnostic areas in Korea and 47 diagnostic areas in Japan. Even though telemedicine in Korea has a relatively short history, it has made some important strides. In particular, the online referral system was established to share patients' medical records on the web among medical institutions. In Japan, telemedicine is used according to each prefecture's social and medical circumstances and most of the prefectures use it to support their regional medical system. In particular, telemedicine is used to assist with the decreasing number of medical institutions and specialists in fields such as radiology and pathology. Korean telemedicine is structured around private medical institutions. Conversely, Japanese telemedicine is led by the central and local governments and various partners.

**Data and Methods**

In exploring the distribution and network characteristics of telemedicine in Korea and Japan, this research focused on Korea's online referral system and Japan's teleradiology and telepathology systems as representative technologies of the existing medical circumstances in each country. The online referral system provides patients’ medical records, such as images, live video, audio recordings and prescription or injection records, to the doctors and medical workers. By exchanging patients’ medical records in the online system, medical institutions can control patients’ medical records easily and doctors can conveniently access patients’ medical records during diagnosis. And although there are differences between teleradiology (i.e., transmitting digitalized images from CT, MRI and other imaging devices) and telepathology (i.e., providing digitally captured glass slides or digital virtual slide images), they both use telecommunications to transmit data and images between two or more sites remotely located from each other (American Telemedicine Association 2009). In Japan, the share of teleradiology and telepathology is more than 50 percent in telemedicine projects (Hasegawa and Murase 2007) and telemedicine systems related to teleradiology and telepathology are regarded as major countermeasures to human resource shortages. Although there are some technical differences between the Korean and Japanese telemedicine systems, the practical use of these technologies in Korea and Japan is identical in terms of providing patients’ medical records to medical specialists and sharing medical information among doctors for diagnosis.

In Korea, the online referral system is in operation in the 62 medical institutions all over the country and 51 of these open their data on the web to other medical institutions providing telemedicine (Park 2004). Therefore, data from the 51 Korean medical institutions providing telemedicine and the 17,783 nationwide medical institutions receiving telemedicine are used in the analysis. The number of medical institutions receiving telemedicine represents 64.5% of the total medical institutions (27,586) throughout the country in 2007. For Japan, the number of medical institutions providing or receiving telemedicine is not very large, mainly because most of the telemedicine applications in Japan are funded by the central and local governments. Each telemedicine application reports the patient data on telemedicine networks, which are released onto the website. Drawing on relevant research and reports, including homepages

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that provide information on the telemedicine practices of each prefecture, this study obtained data on the 398 Japanese medical institutions providing telemedicine and the 1,665 medical institutions receiving telemedicine in 2008. Moreover, two case studies, Choongbook in Korea and Nagano in Japan, are based on these data.

In dealing with the geographical characteristics of telemedicine in Korea and Japan, I have adopted three approaches for my analysis: distribution, network characteristics and case studies. The first method examines the distribution of those medical institutions providing telemedicine or receiving telemedicine by percentage and LQ (location quotient). The first method explains how telemedicine is distributed fairly, or unfairly and how the distribution of telemedicine differs between Korea and Japan, for example, metropolitan-oriented versus local (or rural)-oriented characteristics. The second method presents the relational patterns (network characteristics) between medical institutions providing telemedicine and those receiving it, i.e., how many medical institutions are associated with one another within the same diagnostic area or other diagnostic areas. An exploration of the relational patterns contributes to the discussion on how much telemedicine in Korea and Japan is operated faithfully within a regional-based diagnostic system at a tertiary-care level. In addition, the subjects (medical institutions providing telemedicine or receiving telemedicine) involving the telemedicine networks in Korea and Japan are analyzed in terms of those medical institutions’ size and location. The third approach examines two cases: Choongbook (data from 243 medical institutions of all data) in Korea and Nagano (data from 26 medical institutions of all data) in Japan. This approach focuses on distribution of medical institutions providing telemedicine or receiving telemedicine, the telemedicine networks’ coverage and participants’ characteristics. Both Choongbook and Nagano are close to Kyunggi and Tokyo and are composed of a major city (the seat of the local government), local cities and peripheries; also, each area has the only medical institution providing telemedicine locally. Additional data on national statistics and interviews with telemedicine participants in Korea and Japan are also referred to in this discussion, in particular, to understand social and medical circumstances in each country comprehensively.

Results

Distributional characteristics of medical institutions providing telemedicine and receiving telemedicine

As far as the distribution of telemedicine is concerned, the percentage of medical institutions providing telemedicine in Kyunggi (62.0%) and the percentage of medical institutions receiving telemedicine in Kyunggi (51.1%) and Kyungnam (38.6%) are above average; the percentage of the remaining areas are below average. In particular, medical institutions providing telemedicine and medical institutions receiving telemedicine are concentrated in Kyunggi, which is in the central part of Korea. Half of the medical institutions serving or receiving telemedicine are distributed in Kyunggi (Figure 3). Therefore, medical institutions involved with telemedicine practices in Korea are concentrated, particularly in Kyunggi.

In Japan, most of the medical institutions providing telemedicine and those receiving it are located in or near Tokyo (8.1% and 12.2%), Osaka (3.5% and 8.1%), Aichi (3.3% and 4.8%) and Fukuoka (3.3% and 4.6%), although there are other diagnostic areas, such as Hokkaido and

Figure 3. Distribution of medical institutions providing telemedicine and those receiving telemedicine in Korea by percentage.
Hiroshima (Figure 4). Medical institutions in Japan are focused in metropolitan areas, but institutions that provide and receive telemedicine are not concentrated in such areas, unlike the Korean case. Given these results, the percentages of medical institutions providing telemedicine and those receiving telemedicine provide substantial evidence that both types appear to be gathered in major metropolitan areas. Korea has a more centralized distribution than Japan, particularly for medical institutions providing telemedicine.

In general, the distribution of a given industry is connected more specifically with other industries or populations. With this in mind, it is useful to perform an analysis using the location quotient (LQ), which provides insight into the relative specialization in geography. In particular, not only does LQ explain the relationship between a given industry and other industries or populations, but it also reveals the relative specialization on a national scale (Isard 1960).

With regard to the LQ of medical institutions providing telemedicine in Korea (Table 1), the institutions in the Kyunggi (1.462) and Jeonbook (1.340) diagnostic areas each had LQ indices over 1, whereas most of the other diagnostic areas had LQ indices under 1. In other words, medical institutions providing telemedicine in Korea are concentrated in certain diagnostic areas. Areas receiving telemedicine are observable in Kyunggi (1.001), Kangwon (1.001) and Jeonbook (1.001); most of the diagnostic areas’ LQ indices are close to 1. The distribution of medical institutions receiving telemedicine is diffused across the country. Keeping this fact in mind, Kyunggi and Jeonbook are occupied by a large number of medical institutions providing telemedicine. Kyunggi, Kangwon and Jeonbook are occupied by medical institutions receiving telemedicine; the differences in LQ indices among diagnostic areas are not large.

On the other hand, the southern and northern parts of Japan such as Hokkadio (1.430), Yamagata (2.453), Toyama (3.013), Gifu (2.492), Shimane (5.672), Kagawa

### Table 1. Distribution of medical institutions providing telemedicine and those receiving telemedicine in Korea according to LQ

<table>
<thead>
<tr>
<th>Diagnostic Areas</th>
<th>Medical Institutions Providing telemedicine</th>
<th>Medical Institutions Receiving telemedicine</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kyunggi</td>
<td>1.462</td>
<td>1.001</td>
</tr>
<tr>
<td>Kangwon</td>
<td>0.553</td>
<td>1.001</td>
</tr>
<tr>
<td>Choongbook</td>
<td>0.537</td>
<td>0.999</td>
</tr>
<tr>
<td>Choongnam</td>
<td>0.984</td>
<td>0.999</td>
</tr>
<tr>
<td>Kyungbook</td>
<td>0.908</td>
<td>0.999</td>
</tr>
<tr>
<td>Jeonbook</td>
<td>1.340</td>
<td>1.001</td>
</tr>
<tr>
<td>Jeonnam</td>
<td>0.338</td>
<td>0.999</td>
</tr>
<tr>
<td>Kyungnam</td>
<td>0.557</td>
<td>0.999</td>
</tr>
</tbody>
</table>

Figure 4. Distribution of medical institutions providing telemedicine and those receiving telemedicine in Japan according to percentage.
(2.967), Kochi (4.043) and Nagasaki (2.691) are occupied by medical institutions providing telemedicine and they show higher LQ indices when compared with metropolitan areas (Table 2). Areas occupied by medical institutions receiving telemedicine are observable elsewhere in Japan as compared with the LQ of medical institutions providing telemedicine. Namely, 27 diagnostic areas are occupied by medical institutions receiving telemedicine and most of the diagnostic areas are close to 1. Therefore, medical institutions providing telemedicine are located in the southern and northern parts of Japan, except for metropolitan areas, and medical institutions receiving telemedicine are distributed evenly across the country.

The distribution of medical institutions involved with telemedicine in Korea and Japan show metropolitan area-oriented characteristics centered around Kyunggi in Korea and Tokyo, Osaka, Aichi and Fukuoka in Japan; however, there are some internal differences between Korea and Japan. Telemedicine in Korea is mainly provided by medical institutions in Kyunggi, the central part of Korea; moreover, the concentration of medical institutions providing telemedicine and those receiving telemedicine in Kyunggi is significant. Although the distribution of the telemedicine system is focused around metropolitan areas, the purpose of telemedicine is to assist medical institutions with providing care in local areas (e.g., southern and northern Japan in particular), rather than in metropolitan areas. Accordingly, there are some cherry-picking areas (Lucas 2008) that receive the benefits of telemedicine and these areas are centered around Kyunggi in Korea. Conversely, telemedicine practices in Japan are associated with medical institutions in local areas.

**Network characteristics of telemedicine**

In terms of the network characteristics of telemedicine,
the majority of medical institutions receiving telemedicine in Kangwon (70.2%), Choongbook (65.7%), Jeonnam (70.3%) and Jeonbook (45.1%) are in outlying diagnostic areas, whereas medical institutions providing telemedicine are in Kyunggi (Figure 5). Also, the medical institutions receiving telemedicine in Kyunggi (99.9%), Choongnam (70.2%), Kyungbook (75.7%) and Kyungnam (56.1%) are associated with the medical institutions providing telemedicine located in the same diagnostic areas. However, the medical institutions receiving telemedicine in those diagnostic areas (i.e., Choongnam: 22.8%; Kyungbook: 23.6%; and Kyungnam: 41.1%) rely on metropolitan areas (i.e., Kyunggi) as a secondary health care location. As a result, the centralization of telemedicine in Kyunggi is a significant characteristic throughout Korea, regardless of the original purpose of telemedicine, based on the medical laws in Korea.

Looking into the size and locational characteristics of medical institutions involving the telemedicine networks in Korea (Figure 6), clinics are predominantly associated with the centralization of telemedicine referral relations to Kyunggi. In particular, clinics in Choongbook (80.9%), Choongnam (84.8%) and Jeonbook (81.4%) are bound up with the Kyunggi diagnostic area. Therefore, a lot of clinics, which depend on medical institutions providing telemedicine in the same diagnostic area in terms of the purpose of telemedicine in Korea, refer their patients to medical institutions providing telemedicine in Kyunggi without considering patients’ time and burdens. In addition, medical institutions involving the telemedicine networks in peripheries rely quite heavily on Kyunggi considerably and the telemedicine networks in Korea are led by medical institutions located in peripheries, not urban areas. In particular, the majority of medical institutions in the Kangwon (83.9%) are associated with Kyunggi. Summing up, the centralization of the telemedicine networks to Kyunggi is an outstanding phenomenon in the country and such a geographical characteristic is caused by clinics and medical institutions in peripheries in Korea.

In Japan, it seems reasonable to conclude that most of the medical institutions receiving telemedicine are associated with medical institutions providing telemedicine and are located in the same diagnostic areas and this geographical phenomenon is especially identified in northern and southern parts of Japan (Figure 7). Otherwise, if some medical institutions...
receiving telemedicine refer telemedicine to another medical institution providing telemedicine, most of the medical institutions receiving telemedicine rely on other diagnostic areas, not medical institutions providing telemedicine in metropolitan areas.

Looking into the telemedicine networks on the basis of large-scale regional classification (Hokkaido, Tohoku, Kanto, Chubu, Kinki, Chugoku and Shikoku, and Kyushu), this approach gives the answer in relation to how far medical institutions receiving telemedicine are associated with medical institutions providing telemedicine. Even though some medical institutions receiving telemedicine are bound up with medical institutions providing telemedicine in another diagnostic area, their telemedicine relations don’t go outside the boundaries based on large-scale regional classification (Figure 8). Therefore, even if there are the telemedicine networks between medical institutions receiving telemedicine and far-off medical institutions providing telemedicine, these relations are observable within the boundaries based on large-scale regional classification, and there are a few cases of telemedicine networks between medical institutions receiving telemedicine and considerably far-off medical institutions providing telemedicine. It is clear that such a result can be identified in northern and southern Japan and those diagnostic areas show outstanding regional-based telemedicine operations.

According to the size and locational characteristics of the medical institutions involving telemedicine networks in Japan, they are composed by general hospitals and medical institutions in the peripheries (Figure 9). For the size of the medical institutions involving telemedicine, even though there are some exceptional diagnostic areas such as Fukushima, Chiba, Hyogo, Kagawa, Kochi, Kumamoto, Kagoshima and Okinawa, the occupation of general hospitals as major medical institutions involving telemedicine networks is considerable. Unlike the Korean case, telemedicine networks are carried out by facilities excepting for medical institutions such as sport centers, care houses and companies. As telemedicine operations in Japan are associated with the regional-diagnostic based system, the medical institutions involving telemedicine in the peripheries play an important role as the major operators of telemedicine in Japan.

As a result, Korean telemedicine networks are geographically centralized toward a particular diagnostic area—Kyunggi. Japanese telemedicine shows decentralized networks that predominantly operate within the same diagnostic areas, even though some medical institutions receiving telemedicine are associated with outlying medical institutions.
Figure 8. Referral rate of the telemedicine networks from medical institutions providing telemedicine to medical institutions receiving telemedicine in terms of large-scale regional classification in Japan.

Figure 9. The size and locational characteristics of the medical institutions involving telemedicine networks in Japan.

Source: the size characteristics of medical institutions involving telemedicine networks—data supported by the Hospital Association in Japan, the locational characteristics of medical institutions involving telemedicine networks—the administrative district.
Case studies of Korea and Japan: Choongbook and Nagano

An examination of the case studies of Choongbook and Nagano contributes to a detailed explanation of the network characteristics of telemedicine in Korea and Japan. For Choongbook, 243 medical institutions receiving telemedicine are composed of the following: 9 general hospitals, 27 mid-sized hospitals, 207 clinics. 91 medical institutions receiving telemedicine are located in a major city (Cheongju), 85 medical institutions receiving telemedicine located in local cities and 67 medical institutions receiving telemedicine are located in peripheries (Figure 10). Of the 243 medical institutions in the telemedicine network, 193 institutions receiving these services in Choongbook (79.4%) select the telemedicine networks from an inter-regional level (Table 3). In other words, the selection of the medical institutions outside of the region that provides telemedicine to Choongbook is a remarkable phenomenon. Among those telemedicine networks, 158 medical institutions receiving telemedicine (65.5%) are associated with medical institutions providing telemedicine in the Kyunggi diagnostic area. The next most selected areas are Kangwon and Choongnam and some medical institutions receiving telemedicine select several diagnostic areas at once. Only 41 medical institutions receiving telemedicine were involved with medical institutions providing telemedicine within the same diagnostic area (e.g., in the Choongbook diagnostic area). Nine medical institutions receiving telemedicine revealed multiple telemedicine networks at the regional level and inter-regional levels together. Therefore, there are three types of telemedicine networks within the 243 medical institutions receiving telemedicine in the Choongbook diagnostic area: a regional level, a regional and an inter-regional level and an inter-regional level. The most predominant telemedicine networks are at the inter-regional level; many medical institutions that are receiving telemedicine in Choongbook are associated with medical institutions providing telemedicine in the Kyunggi diagnostic area through the online referral system. These referrals occur regardless of the fact that there are medical institutions providing telemedicine in the Choongbook diagnostic area; the goal of telemedicine is based on the promotion of regional health care in Korea.

In Nagano, the telemedicine networks are structured around Shinshu University Hospital (a telemedicine provider) that is located in Matsumoto; 26 medical institutions receiving telemedicine are involved with this network. The twenty-six medical institutions all receive telemedicine services and are composed of twenty-one general hospitals, four health centers and one care center for the elderly. Two medical institutions were located in Nagano (a major city), seventeen were in local cities and seven were in peripheral areas (Figure 11).
According to the telemedicine networks, 26 medical institutions receiving telemedicine are involved with Shinshu University Hospital at the regional level (Table 4). An examination of the internal telemedicine networks reveals that Shinshu University Hospital provides teleradiology and telepathology to all 26 medical institutions. In addition to providing teleradiology and telepathology, various telemedicine services for children and emergencies are transmitted from Nagano. There are also some cases of inter-regional and international use. For the case of telemedicine networks from an inter-regional level, Shinshu University Hospital was involved with two medical institutions located in Tokyo and Aichi in 1997, but that involvement was only as an experiment. Telemedicine networks at the international level were aimed at supporting the Republic of Belarus; the frequency of use is low and there are some obstacles, such as communication problems in English. The major reason that most of the medical institutions receiving telemedicine make use of regional level networks is to combat the decreased numbers of medical specialists in radiology and pathology, remote emergency medical centers and home care for the elderly. As a result, it is reasonable to say that there are three types of telemedicine networks in Nagano: regional level, inter-regional level and international level networks. Only telemedicine networks from the regional level are successfully deployed on a commercial scale. Additionally, telemedicine networks are mainly established by general hospitals and medical institutions located in local cities and peripheries.

Some diagnostic areas solve medical problems within the same diagnostic area, but in most cases, medical institutions receiving telemedicine in Korea are associated with medical institutions providing telemedicine in the Kyunggi diagnostic area. While medical institutions receiving telemedicine in Japan are associated with medical institutions providing telemedicine, they are generally located in the same diagnostic area. Accordingly, Korea exhibits strong telemedicine networks at the inter-regional level (centralization) and Japan’s telemedicine networks are focused at the regional level (decentralization).

**Discussion**

Originally, telemedicine in Korea and Japan was based on the promotion of a stable regional health care system within each diagnostic area and it was regarded as one of the IT (information technology) strategies for health care. Presently, as previously explained, patients must see medical specialists in person at least once to avoid an incorrect diagnosis in the medical laws. For example, the first diagnosis requires a physical examination; then, the next diagnosis can be processed by using telemedicine. Accordingly, accessibility to, and utilization of, medical institutions is a considerable factor in the success of telemedicine, as in general health care. With regard to the differences between Korea and Japan, telemedicine in Korea has been characterized by the private approach centering on medical institutions for tertiary health care and Japanese telemedicine has been controlled by the public approach.

The sharp geographical contrast in the application of
telemedicine between Korea and Japan is enhanced by centralization and decentralization (Figure 12). In other words, medical institutions associated with telemedicine operations in Korea are concentrated in one specific diagnostic area (Kyunggi); also, it is easier to identify the telemedicine networks at the inter-regional level in Korea, involved with Kyunggi in most cases, than at the regional level. Additionally, medical institutions that participate in telemedicine are distributed evenly in each diagnostic area in Japan. According to an interview with telemedicine specialists from Korea and Japan, such geographical characteristics are influenced by the following: the differences in the traditional health care systems; the related development processes; the cognition of patients and medical workers; and the different purposes of telemedicine in each country.

For Korea, even though the health system, including telemedicine, aims to provide regional health care across the country, the health care system is actually structured around Kyunggi. The central government in Seoul (which is in Kyunggi) is endowed with most of the decision making rights, although some budgetary duties belong to local governments. As far as the priorities of medical institutions are concerned, good medical institutions—and general hospitals in particular—are managed by huge enterprises and universities that are primarily located in or around Kyunggi because of potential demand. Accordingly, it is not difficult to discover distrust and dissatisfaction towards the regional health care system and most Korean residents prefer to be diagnosed in Kyunggi whenever possible. The preference for medical institutions in Kyunggi is attributable to the elderly, certain patients with high social status in local areas, or those that have experienced a misdiagnosis elsewhere. Lastly, the centralization of telemedicine is associated with telemedicine's purpose. At the end of the 1990s, there were various social changes, including health care, because of the monetary crisis. At that time, many doctors became independent from general hospitals in order to reduce the investment toward health care services. Therefore, many general hospitals devised some countermeasures, such as the online referral system, to attract more patients and manage telemedicine customers effectively. At the same time, the introduction of medical informatization took place, and after the end of the 1990s, it focused on very large general hospitals. The purpose of the online referral system was to enhance the regional health care system; also, the private approach has been dictated by social and medical circumstances. As a result, many private medical institutions have focused on making profits rather than improving the balance of nationwide health care and the centralization of telemedicine is one effect of this focus.

With regard to Japan, the primary reason for decentralization is that the Japanese health care system strictly follows the principle of the regional health care system. In addition, various telemedicine practices have been carried out under political control according to the principles of a stable health care system, which has meant supporting isolated communities and secluded places in particular (i.e., a public approach). Therefore, contrary to Korea, Japan's telemedicine exhibits a strongly decentralized nature and the number of telemedicine participants is restricted. The following reasons contributed to the decentralization of telemedicine in Japan: first, the number of telemedicine participants in Japan is few because of the applications of telemedicine and related technologies. Teleradiology and telepathology are the predominant telemedicine technologies in Japan and they need huge investments. Therefore, only some medical institutions that use the telemedicine system can be involved in telemedicine practices. Usually, general hospitals and university hospitals act as both the supplier and the customer. Second, telemedicine in Japan is observable elsewhere, particularly in major local cities. This phenomenon is associated with the construction of networks, namely, the distribution of first generation ISDN (intergrated services digital network) lines which influenced the geographical characteristics of telemedicine (Hasegawa and Murase 2007).

In consideration of the above information, although telemedicine technically operates in cyberspace as an online system, the geographical characteristics of telemedicine are associated with its social and medical
Conclusions

Since the mid-1990s, telemedicine in Korea and Japan has undergone significant expansion. It is regarded as an innovative concept in health care delivery that has contributed to the integration of various medical institutions via telecommunication technologies. Principally, telemedicine in Korea and Japan is influenced by distinctive geographical considerations, even though telemedicine is operated in cyberspace. Although telemedicine in Korea and Japan appears to be associated with major urban areas, the practical operations of telemedicine are different. Medical institutions providing telemedicine and those receiving it in Korea are focused in Kyunggi; also, nationwide medical institutions receiving telemedicine are connected with the medical institutions providing telemedicine in Kyunggi. On the other hand, telemedicine in Japan is centered in each prefecture and the regional-based diagnostic system of telemedicine is an outstanding phenomenon. Moreover, it is difficult to locate telemedicine networks among diagnostic areas in Japan when compared with telemedicine in Korea. Thus, the geographical characteristics of telemedicine bring about a sharp contrast between Korea and Japan through the centralization and decentralization of telemedicine.

All things considered, the following suggestions can be made from the results. In the case of Korea, it is necessary to improve telemedicine services for each diagnostic area. Accessibility and utilization must be considered in order to reduce patients’ travel time and burdens, despite the fact that telemedicine operates in cyberspace. On the other hand, Japanese telemedicine shows strong decentralization based on each diagnostic area; therefore, there are some problems with integrating the individual regional telemedicine systems into a national one. To prepare a safe national telemedicine system, major telemedicine innovators or governors must make a comprehensive plan for the establishment of a stable system because Japanese telemedicine is influenced by the public approach (the central and local governments).

The purpose of this study was to first investigate the supportive evidence of telemedicine in Korea and Japan regarding the geographical problems, distribution and networks of telemedicine. There is still much to be learned about the geographical characteristics of telemedicine in order to address issues such as the following: (1) consideration of more affluent geographical methodologies; and (2) limited data. Clearly, this discussion is limited in scope and further studies such as the detailed actual mechanism of telemedicine from the perspective of patients or doctors should address different assessment methodologies. Those interested in medical practice in cyberspace and medical geographers with an interest in telemedicine should look more closely at this subject.

Acknowledgements

I wish to express my gratitude to Mr. Yoon and Mr. Kang in Korea and Professor Hasegawa in Japan for their helpful suggestions and professional knowledge.

Note

1. In terms of health care, regionalization can be substituted for decentralization, although decentralization lays emphasis on the political approach.
2. The diagnostic areas in Korea are composed of 8 areas. Jeju Island, in which is the southern part, is included in Kyunggi. In addition, the diagnostic areas in Japan are based on each prefecture.
3. The formula of percentage is the following:

\[
\text{Percentage} = \frac{\text{The number of medical institutions providing telemedicine or receiving telemedicine on the basis of each diagnostic area}}{\text{The total number of medical institutions providing telemedicine or receiving telemedicine}}
\]

4. The formula of LQ is the following:

\[
LQ_{ij} = \frac{X_{ij} / X_i}{X_j / X}
\]

\(X_{ij}\): number of medical institutions providing or receiving telemedicine \((i)\) in a given region \((j)\)
\(X_i\): number of medical institutions providing or receiving telemedicine \((i)\) in the nation
\(X_j\): number of total medical institutions in a given region \((j)\)
\(X\): number of total medical institutions in the nation

- \(LQ_{ij} > 1\), specialization is higher than national degree
- \(LQ_{ij} = 1\), specialization is same as national degree
- \(LQ_{ij} < 1\), specialization is lower than national degree (Isard 1960)
References


(K): written in Korean