Telemedicine in Japan 2013

October 2013

Japanese Telemedicine and Telecare Association

contents

1. Introduction

Kazuhiro Hara
Chairperson, Japanese Telemedicine and Telecare Association (JTTA)

The Great East Japan Earthquake of March 2011 devastated the coastal areas of Japan's Tohoku district, resulting in enormous impacts such as the death of health care professionals, the destruction of medical facilities, and the damage or disappearance of medical records. As a result, the government's policy was drastically changed to include the promotion of telemedicine and computer-based patient record networks. For example, the electronic maternity passbook *Ihatove* is a perinatal computer-based patient record network that was conventionally operated in Iwate prefecture. This network was extremely helpful for prenatal care on the coast of the Pacific Ocean that was damaged by the earthquake, renewing awareness of the importance of datacenter (cloud) type medical information technology (IT) networks. It can be said that this fact has historic importance for the spread of telemedicine in the future.

Today, the Japanese government advocates and strongly promotes that two concepts be introduced into telemedicine, home medical and nursing care, emergency care, and preventive health care. The first is Electronic Health Records (EHR) and Personal Health Records (PHR), called *dokodemo my byoin*, which ensure that wherever you go, your personal health record can follow. The second is seamless regional collaborative medical services, including computer-based patient record networks. Furthermore, in an attempt to revive medical services in the disaster area, the induction of telemedicine is being pushed forward.

Personal authentication is essential for the promotion of telemedicine. The "my number" is a common number system that can authenticate an individual electronically. It was established in the Diet in May 2013 and is expected to be introduced to the medical field, particularly telemedicine and computer-based patient record networks, in the future.

Based on this social background, various approaches have been taken all over the country using the research and development expenses of government agencies, including the Ministry of Economy, Trade and Industry, the Ministry of Internal Affairs and Communications, and the Ministry of Health, Labor and Welfare. These approaches include support of remote diagnostic imaging using IT networks, remote medical examinations for pregnant woman, emergency care, home medical care, and monitoring services.

Since 2009, a regional medical care renewal fund of about 450 billion yen has been distributed among all local governments in Japan by the Ministry of Health, Labor and Welfare. Ten percent of the fund is intended to be used for medical IT networks, which means that such networks will be developed all over the country in the future.

We, the Japanese Telemedicine and Telecare Association, have made a commitment to disseminate telemedicine aggressively. As a part of our promotion activities, we have thoroughly supported telemedicine research conducted through a public scheme of clinical studies funded by the Grant-in-Aid for Scientific Research of the Ministry of Health, Labour and Welfare, which led to the publication of the Ministry of Health, Labour and Welfare's notification to promote telemedicine. In addition, our association presented the *Guidelines for Remote Medical Care Including Home Care*. To support the promotion of local communication by the Ministry of Internal Affairs and Communications, as well as telemedicine promotion activities, we have cooperated in the preparation of a reference book on the model of telemedicine. Ethically guiding principles regarding telemedicine are also discussed in the book *Medical*

Ethics, published by the Japan Medical Association, in order to provide clues regarding ideal telemedicine. These descriptions can be found on the webpage of our association as well as that of each relevant ministry and organization.

Japanese telemedicine is currently in the development stage and is spreading rapidly all over the country; yet, its full scope has not been sufficiently understood. Due to this issue, the office of the Japanese Telemedicine and Telecare Association has received many inquiries about Japanese telemedicine, not only from inside the country but also from foreign countries. Therefore, before the International Society for Telemedicine and eHealth's 18th International Conference, which will be held in Takamatsu, we have decided to prepare a document in English to provide clear information about the background, present conditions, problems, and future prospects of telemedicine in Japan for the common citizen. In seizing this opportunity, we plan to share Japanese IT systems—including telemedicine, home medical care, and monitoring services—with the world

2. Definition and Typing of Telemedicine

What is telemedicine?

Ikuo Tofukuji
Takasaki University of Health and Welfare

1. Definition of Telemedicine

In Japan, although telemedicine efforts began in the 1970s, the progress was drastic during the 1990s. In 1996, the Ministry of Health, Labour and Welfare organized a telemedicine research team, with Professor Kaihara Shigekoto of Tokyo University as its team leader. Since there were many initiatives focusing on image transmission during that time, the research team defined telemedicine as "performing medical practices, such as remote diagnosis, instructions, and others, as well as any action related to medical treatment based on the transmission of patient information including image."[1)]

Subsequently, the Japan Telemedicine Society was established in 2005 and the above-mentioned definition was revised. As a result, in July 2006, the Japan Telemedicine Society redefined telemedicine and telecare as "the actions that contribute to health care, medical treatment, and nursing care by using telecommunication technology."[2)] In addition, the "Telemedicine implementation guidelines for patients at home," which were released in March 2011, defined telemedicine as "performing complete medical practice between two far off locations using telecommunication technology."[3)]

Moreover, according to the American Telemedicine Association (ATA), telemedicine is defined as "the use of medical information exchanged from one site to another via electronic communications to improve patients' health status" in other countries.[4)]

2. Definition of terms

In this chapter, we define the following terms broadly.

(1) Medical treatment

Medical treatment is the general term for actions, such as diagnosis, treatment, and medical care performed for recovery from illness; health guidance, nutrition guidance, and exercise guidance performed to promote health; and nursing care performed to improve quality of life.

(2) Patient

It is the general term for the person who receives the above-mentioned medical treatment service. When receiving a telemedicine service, it is assumed that the patient's home is not in the same location as the health care provider.

Although telemedicine is more broadly perceived in this manner, it is important to give sufficient caution since the laws defining the operation framework of its application in medical treatment, health, and nursing are different.

(3) Health care provider

A health care provider is a person who provides medical treatment service to the abovementioned "patient." Health care providers are broadly classified into "physician in charge," who provides service to the patients, and "medical specialist," who assists the physician in charge with his expertise and experience.

3. Types of Telemedicine

At a broad level, telemedicine is divided into two types as shown in Fig. 2-1.

1) Telemedicine for patients

Medical treatment is provided to patients by the physician in charge. A patient at home interacts with the physician in charge located in a remote medical facility through the video telephone system. Simultaneously, based on the transmitted

information, the physician in charge determines the physical and mental condition of the patient and provides assistance to the patient's medical treatment. This type of telemedicine is sometimes referred to as "telecare." "Telenursing" is an example of this type, where a nurse performs a key role and provides assistance to home care patients.

2) Telemedicine between health care providers

This telemedicine is carried out primarily between the physician in charge and the medical specialist, and it is referred to as "narrow sense telemedicine." Based on the expertise and experience of the medical specialist, the physician in charge delegates the highly specialized diagnosis, consults about the treatment plan, and so on with the medical specialist. The interpretation of CT and MRI images from remote locations, teleradiology or pathological diagnosis of tissue or cell specimens collected from patients, and telepathology are representative examples.

It also includes remote learning of highly specialized knowledge and teleconference, a discussion from a professional point of view to bring together the knowledge and experience about a case. In this manual, we outline all types of telemedicine with examples.

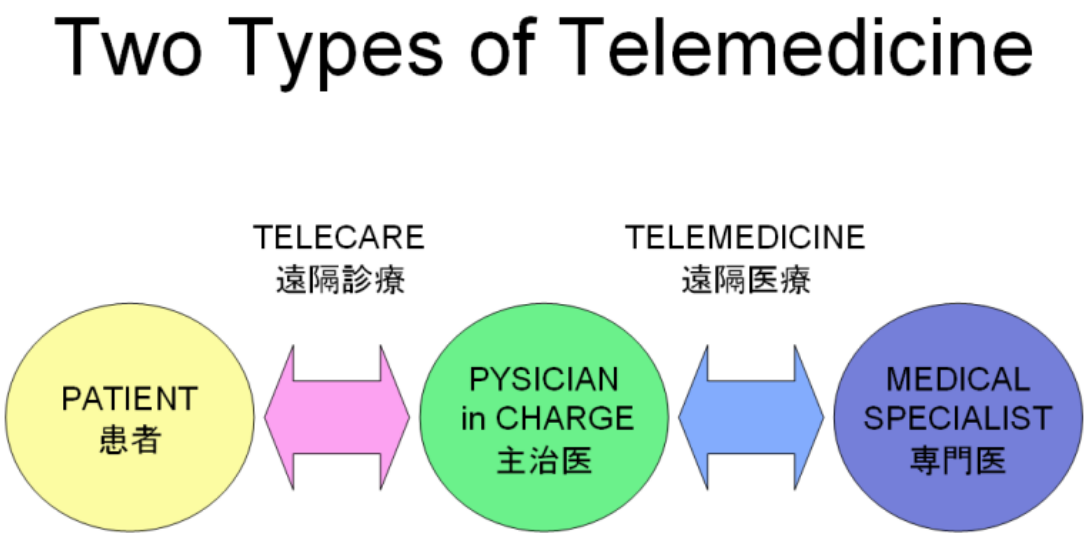

Fig. 2-1 Two Types of Telemedicine

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3. Social background of telemedicine

Hiroyuki Morita

Department of General Internal Medicine, Gifu University Graduate School of Medicine

1. Declining birth rate and aging population in Japan

Currently, Japan is moving toward an aging society at a rapid pace. It is predicted that the declining birth rate and aging population will further accelerate in the future (Figure 3-1)[1].

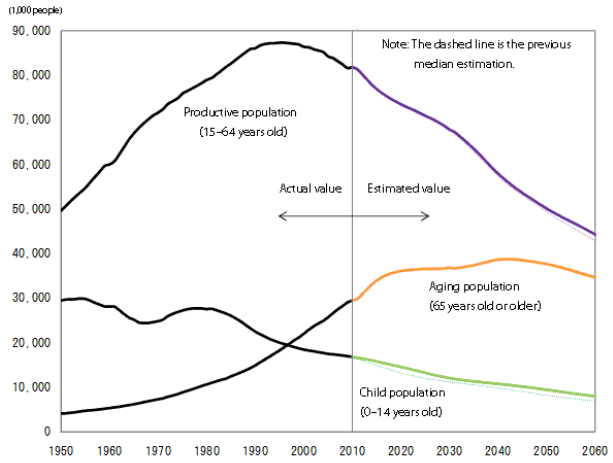

Figure 3-1. Annual population change by three age categories (2010)

In addition to the decrease in recent births, an aging society is the result of a life span that has been extended by universal care, health checkups and advanced medical care, as well as the improved sanitation caused by the maintenance of social infrastructures (e.g., water and sewage) associated with rapid economic development after World War II.

The average life spans of men and women have been the longest in the world since the 1950s. The average life span in 2012 was 86.4 years (1st place, globally) and 79.9 years (5th place) for women and men, respectively (Figure 3-2)[2]. It is expected that the average life span will extend even further in future. Therefore, investigating the issue of declining birthrate is an urgent necessity.

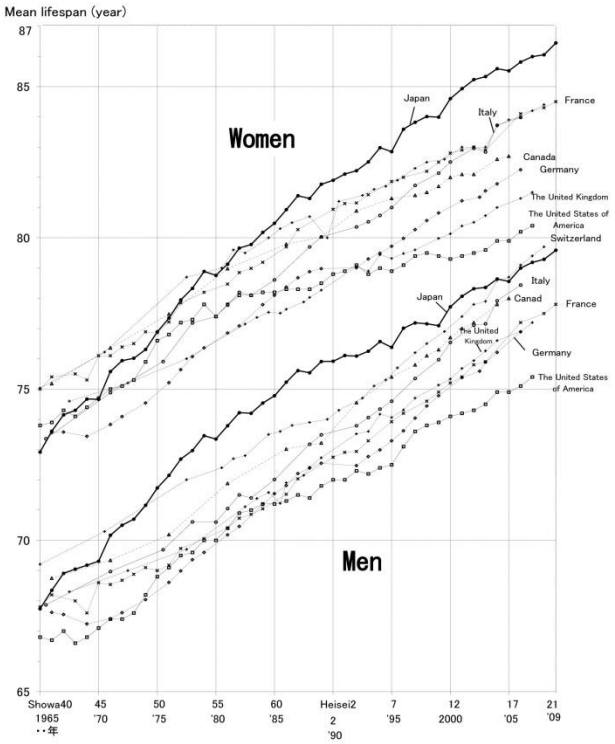

Figure 3-2. Annual average life span change in main foreign countries

The medical cost per citizen, according to the age-grade of 2010 (Figure 3-3)[3], increased as the generation aged, of which the lowest level was in the 10s. Most of the medical costs are incurred by the elderly. It is expected that advanced aging may lead to further increases in medical costs. Thus, in future, more economically effective medical care will be required for the elderly in particular. From this viewpoint, a telemedicine can be useful.

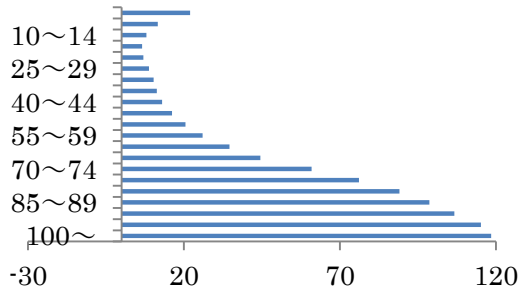

Figure 3-3. Medical cost per citizen according to the age-grade of 2010 (ten thousand Japanese yen/year)

2. Doctor shortage and uneven distribution

The current number of physicians has not yet reached the number of physicians corresponding to the increase of medical demands associated with an aging society. According to the Organization for Economic Cooperation and Development's (OECD) Health Data, which was published in 2009 (Figure 3-4)[4], the number of physicians in Japan was 2.1 per 1,000 people, which was considerably less than the average number shown by the OECD (3.1 physicians). This number was the lowest in the Group of Seven nations (G7), which includes Japan, the United States, and Europe, and was the fourth lowest among 30 countries in the OECD. In addition, the number of nurses in Japan was 9.4 per 1,000 people, which was slightly less than the average number shown by the OECD (9.6 nurses).

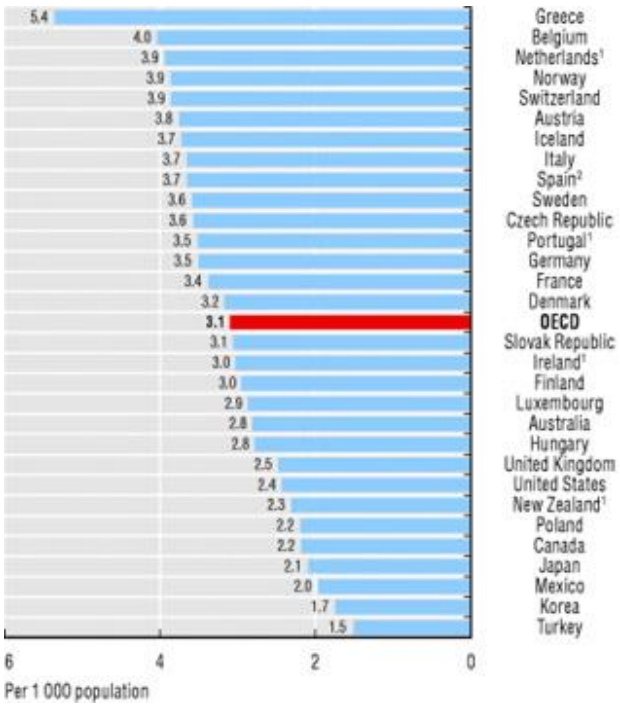

Figure 3-4. The number of physicians in the world

The number of students to be admitted to medical faculties (Figure 3-5)[5] was increased by the plan that at least one medical university would be established per prefecture, based on a cabinet decision in 1973. Although the number of physicians increased to 8,280 from 1981 to 1984, the number of students to be admitted to medical faculties was reduced by the cabinet decisions of 1982 and 1997, to avoid a future surplus of physicians; the figure then declined to 7,625 from 2003 to 2007. The doctor shortage was revealed afterwards. Based on the cabinet decision of 2008, the number of medical students exceeded the number of students to be admitted to medical faculties in some regions, after 2008. The number of medical students in 2013 (9,041) increased to 1.19 times more the number of students to be admitted to medical faculties. However, it takes eight years in total (six years in an undergraduate medical faculty; two years of postgraduate clinical training) until a student becomes a qualified physician, who is able to work in clinical practice. Consequently, the effect of increased students to be admitted to medical faculties since 2008 will appear in 2016 or any year after.

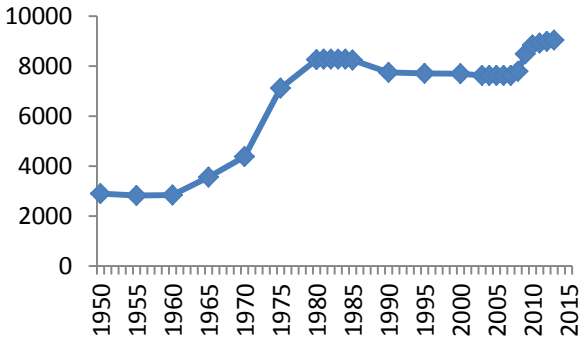

Figure 3-5. Annual change of the number of students to be admitted to medical faculty

The number of physicians by prefecture (municipal division) of 2010 (Figure 3-6)[6] shows the uneven distribution associated with each prefecture population, number of medical faculties, number of years after establishment of the medical faculty, and number of students to be admitted to a medical faculty. This indicates a tendency for the number of physicians to be clearly higher in the West than the East. The Great East Japan Earthquake that occurred on March 11, 2011, seems to have heightened this tendency.

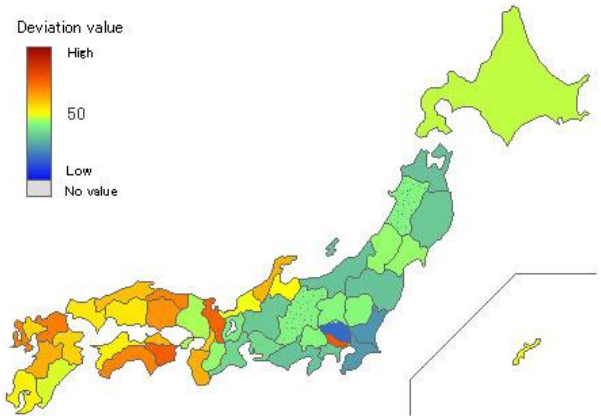

Figure 3-6. The number of physicians by prefecture of 2010

The physician clinical training system, which has been compulsory since 2004, provided many advantages but also contributed to a local uneven distribution of physicians; many physicians work in urban areas, whereas few physicians work in depopulated areas. This uneven distribution was caused because many resident physicians select specialist hospitals for clinical training in urban areas; the dispatch of physicians to local hospitals was compromised by the decrease of young or resident physicians in university hospitals, [4]. A review of the number of students to be admitted to a medical faculty was initiated in 2009. Since July 2011, the system to eliminate the uneven distribution of physicians has been reviewed, ensuring the quality of the clinical training system. After September 2012, in order to eliminate the uneven distribution of physicians, the local prefectural governments have promoted the acquisition of physicians using a "community medical care support center" in combination with a career development support program. However, a long period of time will be required to eliminate local uneven distribution[7].

For departments such as pediatrics, anesthesiology, ophthalmology, radiology, emergency, and pathology, a shortage of specialist physicians in some regions is called “uneven distribution of clinical departments”[8]. The number of such physicians has not increased, but the total number of obstetricians and surgeons has increased (Figure 3-7, 3-8)[9].

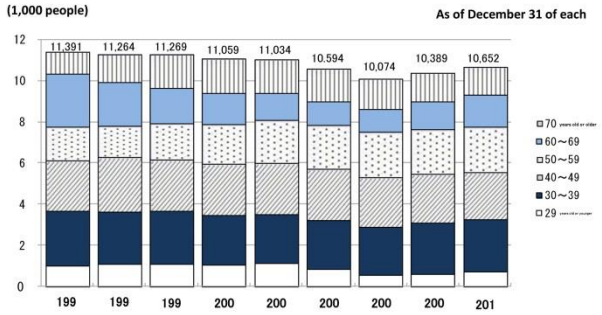

Figure 3-7. Annual change of the number of physicians engaging in "obstetrics and gynecology department/obstetrics"

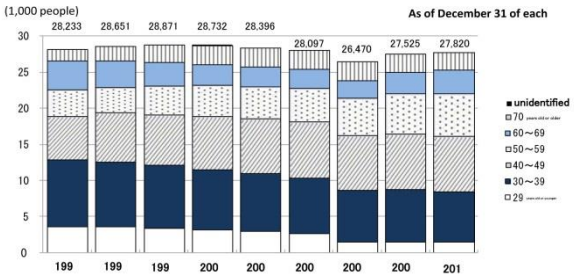

Figure 3-8. Annual change of the number of physicians engaging in "surgery"

In addition, the number of hospital doctors required to work night shifts or long working hours on duty, emergency calls, or operations, who resigned to open a clinic at 30–50 years old, has increased, further accelerating the doctor shortage in hospitals (Figure 3-9, 3-10)[9]. The percentage of female doctors has increased yearly and reached 18.9% in 2010. The workplace environment, in which female doctors can work easily before or after childbearing and while raising children, is important. Some telemedicine, including imaging diagnostics, are possible at home.

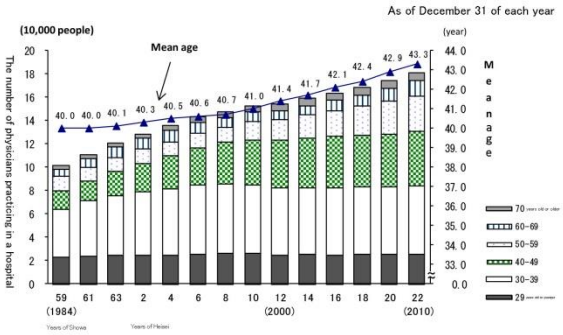

Figure 3-9. Annual change of the number of and the mean age of physicians engaging in a hospital by

age-grade

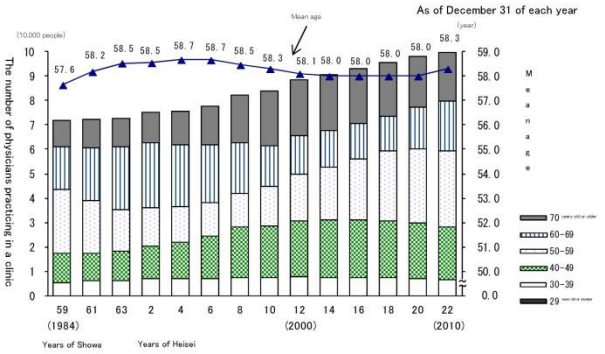

Figure 3-10. Annual change of the number of and the mean age of physicians engaging in a clinic by age-grade

3. Depopulated areas and remote islands

With the maintenance and development of a network of roads, access to local core hospitals has been improved, even in mountain regions. However, the aging rate tends to be generally higher in depopulated areas, and going to hospital in the winter season is difficult in heavy snowfall areas in particular. In addition, even if a physician provides medical visitation, it may take longer than in urban areas, unless the houses are concentrated.

Even if the number of physicians in Japan fills up in the future, in remote islands, the doctor shortage will be difficult to solve. The number of manned remote islands in Japan is 418 as of April 2012. Of these islands, 305 manned remote islands fall under the Remote Islands Development Act; the prefecture which has the most manned remote islands is Nagasaki prefecture (51 islands) (Figure 3-11)[10].

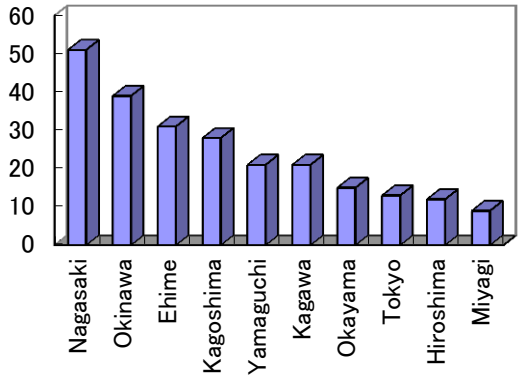

Figure 3-11. The number of manned remote islands by prefecture

Generally, on remote islands the population decline and the rise in aging rate proceed more rapidly than inland depopulated areas[11], which leads to difficulties in the acquisition of physicians. On small islands, there is commonly no medical facility or equipment. Marine navigation necessary for the transfer of emergency patients is influenced by climatic conditions. Helicopters cannot fly at night because of limited visibility. In addition, half or more of remote islands have no heliport[12]. Early treatment is sometimes required, but it is often difficult to judge the nature of the emergency by the patient.

As of 2012, broadband was available in 96.1% of the remote islands[12]. However, optical fiber has not been installed in 80% of the remote islands, which indicates that there is no high-speed communication. The preparation of such a fundamental infrastructure is being promoted by the Ministry of Internal Affairs and Communications, which may play an important role for telemedicine after the communication becomes available in the future[12]. For example, the remote fetal monitoring of pregnant women is very useful in such an environment.

4. Development of medical devices and communication tools

Recently, IT instrumentation and communication environments have been considerably improved. Until several years ago, transmission and reception were difficult using specific devices. Currently the transmission rate has been improved remarkably, even for radio communication. With widely used personal computers, tablets, or smartphones, transmitting and receiving clear video has become easy. In future, 3D video technology and other items with an enhanced sense of reality will be further developed.

Current remote medical care for home care patients relies on an interview and ocular inspection. Real-time consultations with electrocardiogram monitoring, auscultation with an electro stethoscope,

and echo imaging have become available. Tapping and palpation are impossible now but may become possible in the near future. However, portable medical communication devices will be developed, which may narrow the qualitative difference between face-to-face medical services and remote medical services. Thus, it is expected that patients will be able to receive remote medical services without anxiety.

5. Needs of telemedicine by physicians

There are several needs of telemedicine not only between a patient and a physician, but also between physicians. Other than university hospitals, medical facilities where a wide variety of specialists work are limited. There is great need for physicians to consult each specialist about the patients. This is the reason that remote imaging diagnostics, such as the MRI, were developed, or why telepathology is used to diagnose specimens obtained during surgery.

For ophthalmology and dermatology, in which a few specialists work, ocular inspection is mainly used. In regions with no specialist nearby, support from specialists using telemedicine is useful. Telemedicine allows ophthalmology specialists examine a patient using a slit-lamp microscope operated by remote control; in dermatology, a lesion may be magnified more clearly microscopically than grossly.

It is also advantageous to physicians who provide medical care visitations regularly. Currently, visited medical care is required at least twice a month, because medical service is covered under health insurance. If monthly visited and remote medical care are approved for patients who are stable in their conditions, surplus time can be used to provide medical care to other patients, which enables at-home medical services for more patients.

In emergency medical services, if electrocardiogram monitor and respiratory status can be confirmed remotely during the emergency transfer, physicians can instruct emergency medical technicians on the necessary procedures and the preparations for the patient's acceptance may be more precise, which may improve the vital prognosis.

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(all these references were accessed on August 8, 2013)

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4. Telemedicine practices in Japan

4.1 The biggest telemedicine of Japan

Takashi Hasegawa
Gunma University Hospital

1. Background

Teleradiology developed significantly in the 1990s as an increasing number of institutions began to use magnetic resonance imaging (MRI) and computed tomography (CT). The number of medical radiography specialists is about 5000, and two to three times as many MRI and CT devices exist. Furthermore, with the advancement of organ-specific diagnostics, doctor shortage has progressed beyond the ratio of the number of devices versus the number of specialists. Since CT and MRI instruments by nature comprise computers as key components, they are ready for network connection, and radiology departments can easily be involved in telemedicine. In addition, in an era of growing high-speed communication lines and decreasing computer costs, the number of CT and MRI devices grew, and practical telemedicine began in the early 1990s. The development of telemedicine was further enhanced because of the national fee schedule. At the same time, with the spread of digitalized plain radiography devices (computerized radiography [CR]) and nuclear medicine imaging devices (resonance imaging [RI], single-photon emission computed tomography [SPECT], positron emission tomography [PET]), teleradiology has served as a means to alleviate the situation caused by the doctor shortage.

2. Present situation

(1) Information and communication technology, and Digital Imaging and Communications in Medicine (DICOM)

The basic approach is to connect a computer to a diagnostic imaging device (MRI, CT, and the like) and connect the client's hospital and the specialized medical institutions to a computer network (Fig. 4.1-1).

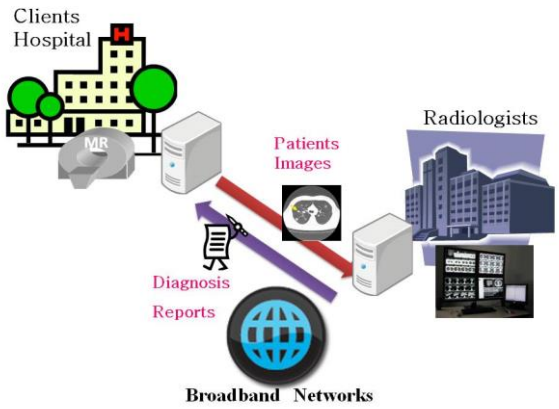


Fig. 4.1-1 Teleradiology

DICOM began to spread in Japan in the early 1990s. Simultaneously, the high-speed communication Integrated Services Digital Network (ISDN) also began to spread, thereby facilitating the development of teleradiology. In the initial phase of teleradiology, just before the spread of DICOM, difficulties were encountered in capturing the patient's image from the video signal lines of a monitor. However, the spread of DICOM resulted in great improvements. The introduction of cable television and Asymmetric Digital Subscriber Line (ADSL) as forms of broadband internet progressed in the late 1990s, followed by a rapid transition to optical fiber systems. As a result, the difficulties in connecting the network and diagnostic imaging devices have been eliminated.

(2) Operation

At the requesting medical institution, radiologists perform imaging with a diagnostic imaging device and send the images to specialists through the communication server. In many cases, the image is transmitted via Picture Archiving and Communication System (PACS). Radiologists capture images under conditions required by the specialist and then send the

image along with related information (examination request and other examination information). Upon receiving this information, the specialist performs a diagnosis and creates a report to be sent to the requesting medical institution. There is no significant difference between telemedicine and the procedure of requesting and reporting diagnostic imaging within the same hospital. This was the foundation of the early development of telemedicine.

(3) Efforts to improve the quality of diagnoses

As soon as teleradiology started to spread, changes occurred in the interpretation system. In order to improve the quality of the interpretation, a team system was introduced. Instead of a single person diagnosing the whole image, specialized doctors diagnose different organs in the image (Fig. 4.1-2).

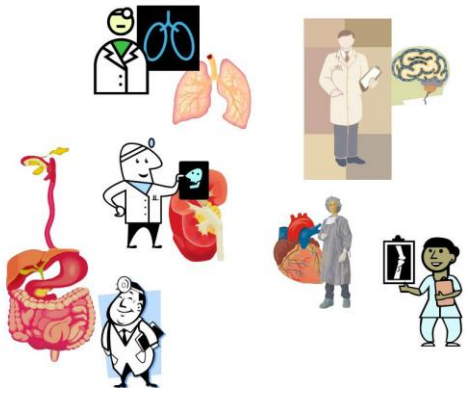


Fig. 4.1-2

In the initial phase of teleradiology, attention was focused on the abundance of diagnostic cases and fraternal stability. However, it is even more important to guarantee the quality of teleradiology, and the establishment of a diagnosis system that utilizes expertise became an important trend. The interest in quality control also increased. Important techniques have been adopted such as other exam data (i.e., blood markers), which serve as background information; other treatment information; comparison with the same patient's previously captured image; mutual understanding of the main point of diagnoses through communication between the doctors at the requesting medical institution and radiologists; and establishment of imaging conditions. Further, various initiatives have been formed such as the organization of clinical conferences for commercial teleradiology operators (described below) and accumulation of important cases.

(4) Appearance of commercial operators

Teleradiology service providers are broadly divided into two forms: the radiology departments of university hospitals or radiology departments of large-scale hospitals with many specialists, and the commercial teleradiology operators. Many commercial operators have appeared, particularly in association with independent-practice-oriented radiologists. Several commercial operators associated with major companies with over 100 client facilities have appeared, but on the other hand, many small-scale businesses also continue to exist.

A new topic among commercial operators is international teleradiology, where a diagnosis is outsourced to overseas operators. Owing to the difference in price, it provides diagnostic services at cheap rates, but there has been much debate about its merits and demerits. This year, a domestic commercial operator association was established.

(5) Trends in regional medical cooperation

In the cases introduced above, attention was mainly focused on the person-to-person relationship between the client and the specialist. However, it is remarkable that there are no individual relationships between the medical institutions lacking specialists and specialized medical institutions. The core medical institutions (university hospitals) in all prefectures also perform teleradiology in an increasing number of regions, either in a regional medical information system supporting a number of hospitals (core hospitals in remote areas within the prefecture) or in a system of regional medical information for cooperation between regional core hospitals and many places of

consultation related to the admission and discharge of patients. The medical institutions originally responsible for regional support are expected to continue expanding their services to include medical radiography. A famous example is the “Ajisai Net” of the National Hospital Organization Omura Medical Center in Nagasaki Prefecture. In addition, in Iwate Prefecture and other prefectures with advanced telemedicine, the Iwate Medical University Hospital and the Iwate Prefectural Central Hospital provide teleradiology to hospitals in several coastal areas.

(6) Fee schedule

National fee schedule claims are possible in teleradiology. There are two types of medical fees: medical fees when visiting a large-scale hospital and medical fees when commercial operators are also involved. The appropriate option will be used according to the circumstances of each medical institution.

3. Problems

(1) Number of practicing facilities

According to the statistics from the Ministry of Health, Labour and Welfare concerning all medical institutions, more than 2,400 teleradiology examinations were performed in 2011. However, the current situation is unclear because commercial operators are not included in the statistics, and the total number of patients (number of images) is unknown. Clarifying the actual situation is indispensable to solving the problem.

(2) Quality improvement

We have introduced initiatives to improve the quality of diagnoses, but quality improvement is only possible in the context of the relationship between the client and the specialist. Social quality assurance activities, such as those provided by a third-party evaluating institution, are desired.

4. Summary

Teleradiology is the earliest established form of telemedicine. However, it is far from being solid and secure. The intensification of activities, such as quality improvement, is desirable.

4.2 Telepathology

Yasunari Tsuchihashi

Louis Pasteur Center for Medical Research

4.3 Telemonitoring with Vital Sensors

Telemonitoring

Satoki Homma

Department of General Medicine,School of Medicine, Kyorin University

1. Purpose of telemonitoring

For remote physical examinations, a videophone is used as a communication tool that enables also visual observation (inspection). However, remote examinations cannot carry out inspections using all the five human senses, particularly brought by face-to-face medical examinations. The telemonitoring system including various kinds of measurement devices can provide useful, quantitative, and objective bio-information in remote medical examination, under the abovementioned situation that medical decision has to be done with limited information.

2. Types and indication methods of telemonitoring

Telemonitoring can be used in the two different situations; a temporary use in which the data are sent at the same time when medical examination is performed remotely; and a usage of consecutive monitoring in which measurement is routinely conducted by the patient or patient's family in order to refer to daily chronological data at the time of medical examinations (see the left side of Patient's Home in Figure 4.3-1). In a temporary usage, monitoring data are utilized as real time data, but not as chronological one. On the other hand, a consecutive monitoring data is accumulated in a server. In such settings, the data should be accessible at any time. Therefore, a strict control of stability in data transmission is not required, whereas a careful management for security of personal information accumulated in a server is required.

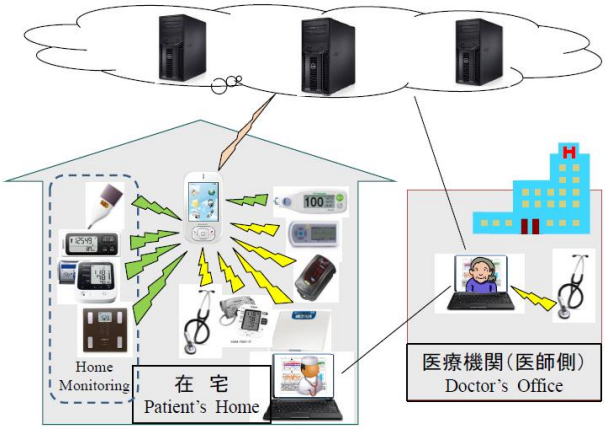


Figure 4.3-1. Image of telemonitoring

疾 患 (Diseases)	pedometer	sphygmomanometer	weighing scale	pulse rate*	blood glucose meter	thermometer	pulse oximeter	ECG monitor	stethoscopes
慢性閉塞性肺疾患 (Chronic Obstructive Disease)	M		M			M	M		M
うっ血性心不全 (Congestive Heart Failure)	※		M	M			M		S
本態性高血圧症 (Essential Hypertension)		M		M					
糖尿病 (Diabetes Mellitus)	※		M		M				
気管支喘息* (Bronchial Asthma*)						M	M		S
不整脈 (Arrhythmia)								M	
認知症 (Dementia)	M		M						
肺炎 (Pneumonia)						M	M		S

Table 4.3-1. Types of telemonitoring adjusting to each disease (M, routine monitoring; S, disease where the temporary "spotty" usage is indicated)

The remote auscultation system, which is convenient for the assessment of respiratory or cardiac diseases, is an example of temporary using at real time in remote medical examination (Figure 4.3-2). Remote auscultation is available not only for the follow-up of chronic diseases, but also for diagnosis of onset of acute diseases such as pneumonia or asthma attack when triage based on the additional symptoms that occurred during the period of remote medical examination is required (Table 4.3-1).

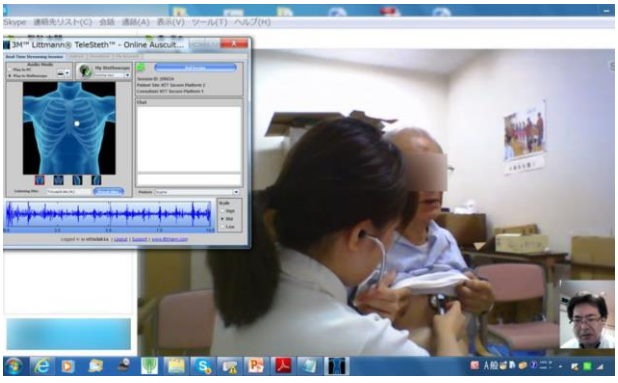


Figure 4.3-2. The videophone screen for remote auscultatory. Hearing at the same time with stethoscopes both in the patient's side and physician's side (see small sub-screen at the right lower corner) (prototype; 3M Health Care Co. Ltd.)

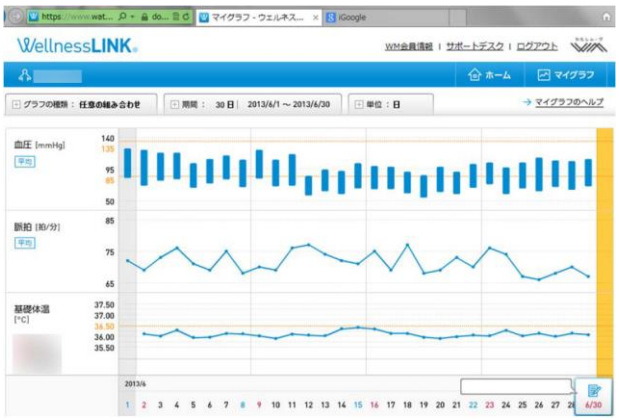


Figure 4.3-3. The screen showing downloaded monitoring data registered in servers (from the WellnessLink provided by the Omron Healthcare, Inc.). Daily monitoring data for one month of blood pressure (upper), heart rate (middle), and body temperature (lower) are indicated.

Examples of the indications using information-storage type of medium- and long-term telemonitoring (Figure 4.3-3) are as follows: 1) hypertension control by measuring home blood pressure (included in the Guidelines of the Japanese Society of Hypertension; it is applied to clinical trials because the objectivity of the data is higher than that of the patient's self-report data); and chronic diseases control itself (e.g., diabetes management by measuring blood glucose); 2) monitoring to provide appropriate intervention by finding out the pathologic changes of chronic diseases at an early stage (to obtain signs of asthma attack and aggravated infection in patients with chronic obstructive pulmonary disease; and to apply it to peritoneal dialysis management); 3) function to watch over elderly people (oftentimes, physical activity is reduced and/or body weight decreases when the dementia is progressing, as shown in Table 4.3-1). Particularly, elderly people often show no typical symptoms, such as dyspnea in respiratory and congestive heart failure, and fever in pneumonia with the acute aggravation of each chronic disease. Therefore, serious physical changes can be found by detecting the reduction in physical activities evaluated by a pedometer and the body weight loss over time.

Figure 4.3-4. Health monitoring. Clockwise from top left: blood pressure, body weight, monthly average number of steps per day, and steps per day.

Considering that people from the information technology (IT) generation use these tools, one of the advanced products for general users is the program for healthy monitoring for the control of metabolic syndrome. Although the combination of pedometer, weighing scale, and sphygmomanometer is common, lifestyle behaviors, such as exercise and dietary habits, are improved only by monitoring these data and checking own time-series data, which frequently lead to success in weight reduction (Figure 4.3-4).

3. Available tools with the telemonitoring apparatus

In order to perform telemonitoring, a vital sensor that can send out data by any kinds of transmission method has to be prepared. Table 4.3-2 shows the list of the sensors commercially available that certified by (or plan to be certified by) the Continua (the company alliance to promote the standard norm and enable the interconnection and use of health instruments). Of these sensors, Bluetooth indicates a wireless transmission. Among Near Field Communication (NFC), Felica is popularly used as one of the standards in Japan.

Table 4.3-2. Available commercial vital sensors with telemonitoring apparatus (certified by or plan to be certified by Continua alliance). ¶; under development

生体センサ（Sensor）	出力通信方式（Transmission Method）
血圧計 (sphygmomanometer)	USB, Bluetooth*, NFC*
体重計 (weighing scale)	Bluetooth*, NFC*
活動量計（pedometer）	USB, Bluetooth*, NFC*
体温計 (thermometer)	NFC*
動脈血酸素濃度計 (pulse oximeter)	USB, Bluetooth*
血糖自己測定器 (blood glucose meter)	NFC
携帯心電計 (portable ECG monitor)	USB
電子聴診器 (electronic stethoscopes)	Bluetooth¶
ピークフローメータ (peak flow meter)	USB

Free data registration services (WellnessLink [http://www.wellnesslink.jp/] and “goo karada log “ [http://karada.goo.ne.jp/]) are available for NFC* and Bluetooth*, which are shown in Table 4.3-2, respectively.

4. Problems - before launching telemonitoring

Apart from the commercial tools mentioned above, the protocols related to the operative aspects of the remote medical examination (integration of data dispersed to multiple servers; personal identification and record method of data) are required to be established by each user. Providing packaged services of these protocols is really desired.

4.4 Telemedicine for pregnant women

Telemedicine for pregnant women and telecare at home

Toshihiro Ogasawara

Iwate prefectural ofnato hospital department obstetrics and gynecology

1.Definition of prenatal telemedicine

Telemedicine is defined as "Performing medical practices such as diagnosis and instructions from a remote location, as well as performing any action related to medical treatment, based on the transmission of patient information containing images."

Prenatal telemedicine is a branch of telemedicine that deals with pregnant women. It is defined as "Performing prenatal care using telemedicine techniques" (Table 4.4-1).

Table 4.4-1 Definition of prenatal telemedicine

It is defined as "Performing prenatal care using telemedicine techniques." * Telemedicine is defined as "Performing medical practices such as diagnosis and instructions from a remote location, as well as performing any action related to medical treatment, based on the transmission of patient information containing images."

In this paper, we introduce the history, necessity, objectives, and mechanisms of prenatal telemedicine, using examples. In addition, we outline the prospects of telemedicine for pregnant women.

2.History of prenatal telemedicine

In November 1998, Japan's first prenatal telemedicine was attempted by Ogasawara with Natori and team in the Kuji region of Iwate prefecture[1)]. It was carried out using a dial-up connection, a 64 kbps analog line, and a combination of videophone and fetal heart-rate monitoring system. Since the connection speed was slow, it took about 30 to 40 minutes for the waveform transmission (Figure 4.4-1). However, since PC communications have become widespread, the utilization survey for pregnant women has become popular. We installed transmission end PCs (that is, the pregnant patient's location) in the municipal health centers of Kuji city, Noda village, ex-Ohno village, and ex-Yamagata village. We performed the fetal heart rate monitoring in the presence of public health nurses. The pregnant women were able to receive health guidance from public health nurses and telecommunicate with the doctors using video phones (Figure 4.4-2).

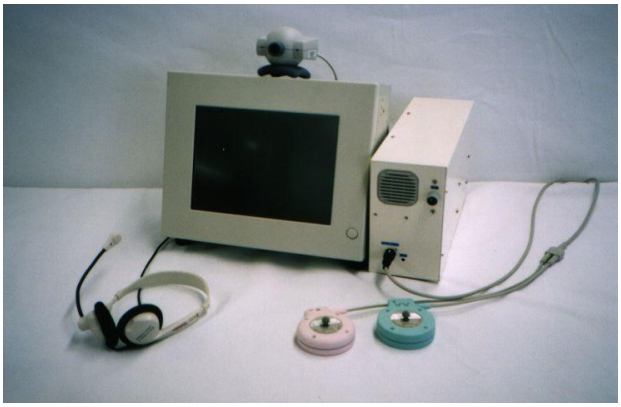


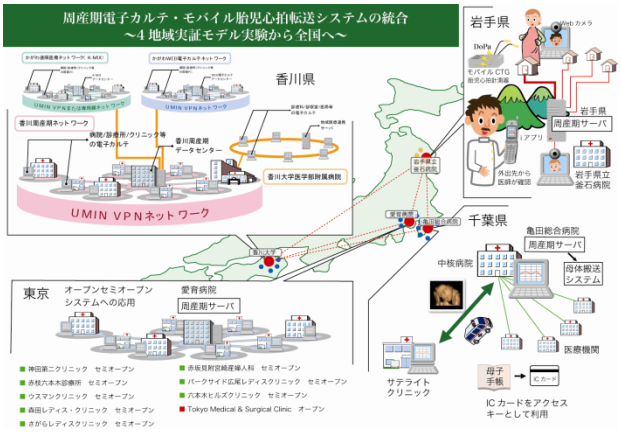
Figure 4.4-1 Prenatal telemedicine experimental device of 1998

Figure 4.4-2 Prenatal telemedicine in the north municipality of Iwate prefecture

Thereafter, there were reports about the effectiveness of prenatal telemedicine in home care[2] from the southern regions of Iwate prefecture (Ichinoseki region), the Kamaishi region, and others.

As a result of these efforts, the Ministry of Economy, Trade and Industry launched a project called “Standardization and demonstration project of the Regional medical information coordination system” from 2006 to 2008, in four locations across the country (Kagawa prefectural Kagawa University, Tokyo Aiiku Hospital, Chiba prefectural Kameda General Hospital and Iwate prefectural Kamaishi Hospital)[3] (Figure 4.4-3).

Figure 4.4-3 Regional demonstration model



In this project, a serious problem we anticipated was the lack of obstetricians and gynecologists in Iwate prefecture. Thus, Iwate prefecture is a model of maternity care in depopulated areas with poor transportation access, a vast geographical area, mountainous terrain, and harsh weather conditions. We developed a popular home based pregnancy management system that uses web video communication technology, and reviewed the effectiveness of this prenatal telemedicine. Using the network between the areas without maternity consultation facilities and key hospitals, as well as between regional midwives, and remote medical care system, we constructed an integrated system that spread beyond the existing areas. A prenatal telecare system was constructed at the Ofunato hospital and the Kamaishi hospital in Tono, Iwate prefecture, by the project of Ministry of Economy, Trade and Industry.

3.Mechanism of Prenatal telemedicine

The midwives in the areas where there are no gynecological facilities transmit information about the fetal health condition and uterine contractions to the mobile phones of hospital doctors by visiting the homes of target pregnant women or installing a mobile cardiotocography monitoring system at the health center. Concurrently, the midwives enter the prenatal checkup results in the web version of perinatal electronic medical records. Thus, the sharing of prenatal checkup information is made possible. The midwives and gynecologists can mutually view or enter the medical examination data in real time. Subsequently, interviews can be conducted with the pregnant women by web video communication through the internet, using web cameras and microphones, as if the prenatal checkups are being performed in hospitals.

With the development of a mobile home-prenatal care system, constant data transmission by pregnant women or midwives is made possible using a small and lightweight mobile fetal heart rate monitoring device (Figure4.4- 4).

Figure 4.4-4 Mobile Cardiotocography monitor

The web version of electronic medical records can be entered wherever internet is available. Thus, information can be shared in real time between the midwives and gynecologists (Figure 4.4-5).

This system is being developed in the Ihatov, Iwate prefectural perinatal care information system.

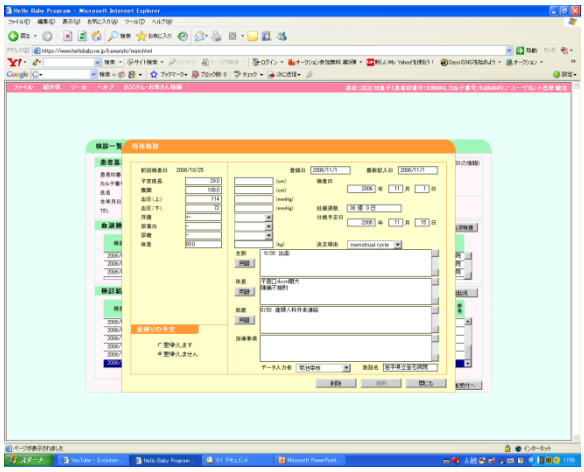


Figure 4.4-5 Web version of electronic medical record

Moreover, even in remote locations, with web video communication technology, using an internet browser that communicates with a 30 to 300 megapixel web camera and headset, prenatal checkups, health guidance and conversation between doctors and midwives or pregnant woman are similar to those in a hospital (Figure 4.4-6). For security, voice and video are communicated using a unique protocol. Operations such as text transmission and file sharing are performed using SSL-VPN.

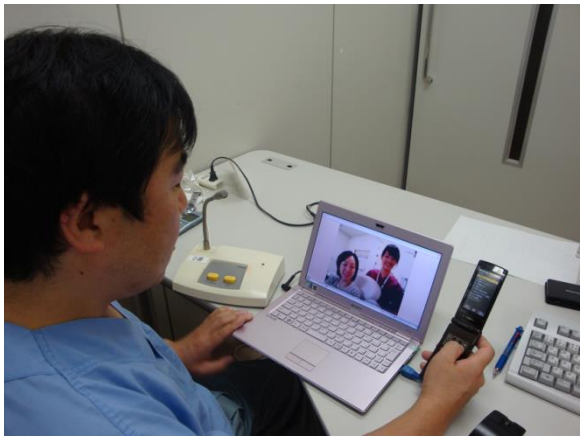


Figure 4.4-6 Video communication using web camera

4.Application of home medical care system in preterm labor

For 3 years, we have been performing prenatal care for pregnant women with preterm labor, who receive medical treatment at home or at the nearest health centers, using the mobile fetal heart rate waveform transmission system.

During the demonstration with actual preterm labor pregnant women as subjects, two cases were telephonically advised to take bed rest at home and one case was advised to make a hospital visit (Table 4.4-2).

Table 4.4-2 Procedure for preterm labor management at home

1.	**In advance, take the transmission training 3 times**
2.	**Set the wearing time as 40 minutes**
3.	**Transmit once a day**
4.	**Make 1 week as a course**
5.	**Attach the probe unassisted**
6.	**Decide the wearing time unassisted**
7.	**Transmit even when uterine contractions begin**
8.	**The doctor contacts only if there is any abnormality**

With this system, it is possible to carry out prenatal care, even from remote locations. Moreover, pregnant women taking bed rest or those who underwent preterm labor treatment feel supervised by medical institutions, even after being discharged from hospital, offering them a sense of security.

5.Application of home medical care system for pregnant women after the due date

It is necessary to monitor pregnant women after the due date, since there are risks such as fetal placental dysfunction, fetal macrosomia, and fetal meconium aspiration syndrome. Moreover, the pregnant women themselves might become anxious about the time of delivery. Therefore, we selected 25 pregnant women, who were pregnant after their

due dates (40 weeks 0 days of pregnancy) as subjects, and applied the home medical care system. These pregnant women had reconfirmed their due dates from the ultrasound values of early gestation and they did not opt for a labor promotion at 40 weeks 0 days of pregnancy. Moreover, the subjects had scored less than 3 points in the pregnancy risk self-management table during the latter half of pregnancy. They had given their consents for the experiment. We lent the device after explaining the method of using the mobile fetal heart rate transmission system and the method of attaching the probes (Figure 4.4-7).

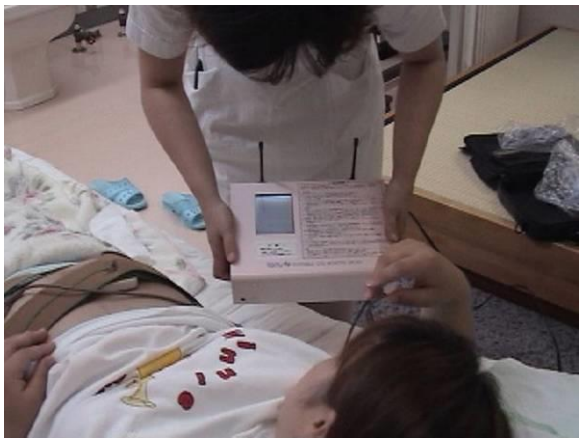


Figure 4.4-7 Probe self-attachment guidance

The pregnant woman mounts the transducer on her own. She transmits once a day, from 9 AM to 10 AM. The recording time is set to 40 minutes.

On receiving the measurement through email notification, the doctor makes the diagnosis by looking at the waveform. Waveform regeneration is diagnosed by the "waveform regeneration application" on the computer.

Out of the 25 trial cases, 7 were excluded because of the commencement of labor pain. Because the pregnancies were extended beyond the due date and the due date was also dependent on the state of the subjects, prediction about delivery was not possible. Eighteen patients completed the trial without any difficulty in sending and receiving. The pregnant women can mount the two transducers by themselves, which extends the possibility of prenatal home care significantly. Moreover, it is also applicable for prenatal self-management.

With respect to safety, the outcome for all 18 cases was satisfactory. It was possible to analyze baseline variability and uterine contraction waveforms. Two cases received telephonic instructions for reconfirmation [4].

Figure 4.4-4 Case that received telephonic instructions for confirmation of baseline variability

In this way, the mobile fetal heart rate waveform transmission device is suggested for conditions such as preterm labor and intrauterine fetal growth retardation. In addition, the user surveys suggest that this device is beneficial to the users, as it offers a sense of security. Moreover, this device is capable of diagnosing the timing for hospitalization, from remote areas. In future, this device would play a vital role in obstetric management in remote areas.

6.Application in transmission of fetal heart rate monitoring during emergency transport of pregnant women by ambulance or helicopter

During maternal and fetal emergency transport by ambulance or helicopter, it is important to continuously monitor, record, and transmit the fetal heart rate, and share the information with many medical institutions to ensure safety. In particular, it is necessary to study its usefulness in the regions

that are far from the destination hospital, or where the transportation time is longer. We examined the usefulness of the portable fetal heart rate transmission system by experimenting on a pregnant woman, for whom emergency transportation was necessary.

After obtaining consent from the subject, the portable fetal heart rate transmission system was mounted and an emergency transportation of the case was done from the regional hospital to our hospital. The distance between the regional hospital and our hospital was 46.6 km, and the travel time was approximately an hour. Investigations were done during transport by diagnoses of the data transmission and reception conditions, and waveform regeneration methods.

Consequently, it was easy to mount the transducer inside the ambulance. Mobile data transmission was not possible outside the FOMA network range but became possible once we entered the network coverage area. The received data was satisfactorily regenerated using a computer application.

Similar to the printed waveform, the waveform regenerated by the regeneration application was diagnosable. This verified that fetal heart rate transmission is possible from a transport vehicle. It has been shown that the transmission of fetal heart rate pattern, recorded during transportation by an ambulance, is helpful for planning the treatment at the destination medical facility. Moreover, it has been shown that the transmission of medical data is possible even in the areas that are out of range, and from a moving vehicle. The challenge in future is to build a system to coordinate this data with the electronic medical records (Figure 4.4-5).

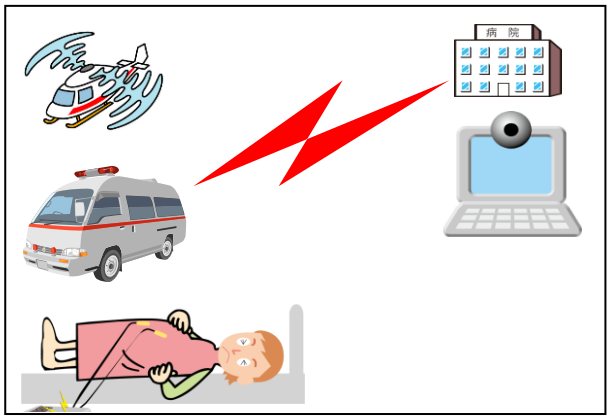


Figure 4.4-5 Mobile fetal heart rate waveform transmission

7.Application of fetal ultrasound image video transmission in prenatal telemedicine

We developed an ultrasound video transmission device and have used it in prenatal telemedicine. With the recent progress in the integration of perinatal facilities, telemedicine by transmission of fetal ultrasound video image over the internet seems to be extremely useful. In the fetal ultrasound video transmission system, FLV format is used in the ultrasound video live transceiver and the conference voice-video transceiver. A UXGA (1600×1200) video monitor is used. Using a conference video audio transceiver, it is possible to share live video while teleconferencing from a remote location (Figure 4.4-6, Figure 4.4-7).

Figure 4.4-6 Fetal ultrasound video transmission system

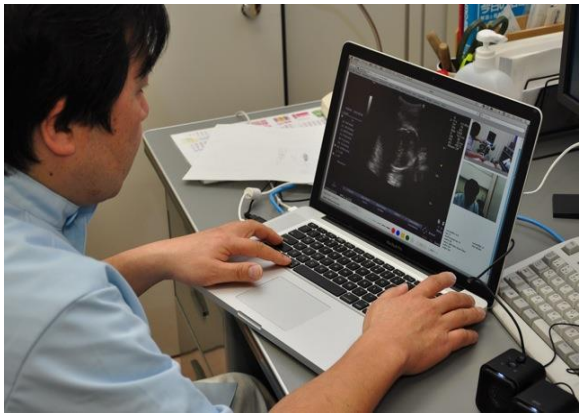


Figure 4.4-7 Fetal ultrasound video transmission system

Figure 4.4-8 Prenatal telemedicine guide

With ultrasound live video, using UXGA (1600×1200), an image equivalent to the usual ultrasound can be reproduced, and it is possible to observe fetal cross section, placenta, and amniotic fluid. Moreover, using the conference video/audio transmission, the probe operation can be simultaneously verified through verbal instructions. Live video-sharing conference between medical institutions has become possible and, at the same time, case consultation with the Integrated Perinatal and Infant Care Center can be performed. Moreover, it can be used as auxiliary prenatal care in maternity hospitals and outpatient midwifery.

8.Prenatal telemedicine guide

We created the “Prenatal Telemedicine Guide” in the construction and demonstration project of the Open Medical Information System that targets perinatal care in the Regional Medical Information System, Standardization and demonstration project of the Regional Medical Information System (Ministry of Economy, Trade and Industry project, 2006). People can use prenatal telemedicine in the areas where its operation has commenced (Figure 4.4-8)[3].

1. Toshihiro OGASAWARA: Usefulness of the Supporting System for Pregnant Woman at Home Networking between Kuji Prefectural Hospital and Local Municipalities, Journal of Iwate Prefectural Hospital, 39 23-28 1999
2. Toshihiro OGASAWARA: New initiatives in the areas with no Obstetrics and Gynecology Department due to the lack of Obstetricians and gynecologists, Child Health 10 (6) 2007
3. Medical Information System Development Center: Ministry of Economy, Trade and Industry project, 2006, Standardization and demonstration project of Regional Medical Information System, Construction and demonstration project of Open Medical Information System that targets perinatal care in the Regional Medical Information System
4. Toshihiro OGASAWARA: Usefulness of mobile fetal heart rate transmission system in post-term pregnancy, Actual case in the Department of Obstetrics and Gynecology 57 (13) 2185-2189 2008

4.5 Home telemedicine and home care

Takashi Hasegawa
Gunma University Hospital

1. Introduction

Some fields are attempting to incorporate remote practice (home telemedicine) into home care practices, expecting it to be a means for providing home care to areas underserved by physicians. Here, we consider the example of Okayama Prefecture's Niimi City, a large-scale setting for implementation, to develop an outlook on home telemedicine as part of home care.

2. What is "home telemedicine"?

There are many instances where tight medical practice, such as acute-phase care, is not provided to home care patients. Care by visiting nurses is the foundation for providing physician management. Many home patients are elderly, and in a majority of cases suffer from multiple overlapping chronic diseases. Moreover, their diseases receive more simultaneous follow-ups than with new diagnoses.

Abroad, telemedicine for home patients seems to more often involve nurses providing telenursing to manage chronic diseases, and less often involve physicians communicating directly with the home patient through videoconferencing. The system in Japan, however, is one where physicians practice for treating home patients, and are even involved in care. A number of efforts have been made for this to be additionally supported by home telemedicine, implemented by the physician for the patient, and transferred from the physician to the home patient's nurse.

The legality of home telemedicine has been a matter of concern, falling under the non-medical examination and care prohibited by Article 20 of the Medical Act. Three times since 1997, the Ministry of Health, Labour and Welfare has issued notifications and their revisions dispelling these concerns and advancing social awareness of home telemedicine as a means for alleviating the burden of hospitalization for home patients, and for physicians to provide more efficient clinic visits.

Between one clinical visit and the next, the implemented technique centers on remote-practice, such as visiting nurse-assisted observation or guidance offered using videoconferencing, or where nurses and others can obtain "pre-practice" in advance of a clinic visit.

3. Current circumstances of home care

10~20 years ago, Japan had more hospitals, with no distinction between institutions for acute care and convalescent care. Long-term hospitalization for elderly patients with chronic disease was common, and the mean number of hospital days was very high, compared to Western hospitals. An undertaking was made to allow patients to return home, allow them to return to their normal living environment, and to streamline medical resources. This was part of an effort by the Ministry of Health, Labour and Welfare to reduce the mean number of hospital days, condense the number of hospitals, and cultivate hospitals highly capable of chronic treatment. Additionally, medical fees benefited from measures that are advantageous to acute care hospitals with shorter hospital days, and capable of advanced treatments. This was accompanied by efforts such as consolidating the previously numerous

National Hospitals. This has resulted in shorter hospital stays, and streamlining into more powerful hospitals.

For a patient to return home requires various infrastructural preparations, including advancing home care and increasing elderly facilities equivalent to being at home. Regions far from metropolitan areas, however, suffer a significant lack of infrastructure for local acceptance, including a shortage of physicians and paucity of practitioners who embark on home care. Despite the serious shortage of physicians for local home care, very broad regions must be traversed for clinical visits, and conditions are not ideal. This has led to an increase in the number of regions attempting home telemedicine with video-conferencing.

4. Undertaking by Okayama Prefecture's Niimi City

1) About Niimi city

In the middle of the Chugoku Region, between Kurashiki on the Seto Inland Sea side and Matsue on the Sea of Japan side, lies a region with approximately 34,000 inhabitants, and an aging rate of about 35%—meaning a small population and advanced aging. With only 4 hospitals, 15 clinics, and 19 care facilities, a vast area stretching 50 km north, south, east, and west faces a serious predicament in terms of providing home care.

2) Home care support system society

Beginning in 2004, the society was established by Niimi Medical Association, Niimi City, Niimi College, visiting nurses in the region, and ICT professional suppliers, initiating an undertaking into remote telemedicine.

3) Niimi City information infrastructure construction project (last one mile project)

Home telemedicine relies on high-quality videoconferencing. This necessitates a broadband communication network throughout the entire city. Laying the groundwork for this, Niimi City connected the last mile for all homes (approximately 12,000 households), enabling all households to enjoy high-speed communication. Operations began in April 2008. At the time, this operation was groundbreaking in Japan.

4) Implementing various enterprises

Since the initiation of the Ministry of Internal Affairs and Communications's Home Telemedicine Model Project (beginning in October 2008), it has been adopted every year by national ministry and agency enterprises, and efforts continue have been made for home telemedicine. There has been a gradual shift to infrastructural enterprises for home care, such as the Ministry of Health, Labour and Welfare's home care regional alliances-based enterprise.

5) Developments and transitions in home telemedicine equipment

When the enterprise was beginning, the country lacked any communication equipment for smooth telemedicine. High-quality videoconferencing by broadband communication did exist, but none was suitable for operations in telemedicine; independent development led to the development of a mobile communication terminal with an external camera, capable of the enlarged imaging of the affected area (the Ishin-Denshin). Now, tablet computers such as iPads are also used.

5. Development of home telemedicine

1) Characteristics of remote telemedicine

Telemedicine in home care, unlike with acute medical care, is greatly significant in

terms of controlling care using visiting nurses, more than diagnosis. Sometimes implemented at the patient's home from the clinic, it may also be oriented towards the nursing home like the patient's home

Fig. 4.5-1 Isihn-Denshin

2) Managing telemedicine

No matter how much videoconferencing improves, visiting nurses are essential for telemedicine sessions. This matter is also specified in the guidelines for home telemedicine, by the Japan Telemedicine and Telecare Society. Telemedicine is carried out by interpolation, in combination with visitation by attending physicians, who provided clinical visits for their patients. Telemedicine should be the same as face-to-face medical care provided by a physician. Therefore, telemedicine provided by a physician who has never treated patients face-to-face is not possible.

Fig. 4.5-2 Home telemedicine (clinic to - patient's home)

3) Deployment to nursing in telemedicine

Home care is to return the patients to their home environment to support life. There are many challenges beyond just medical examination by the physician, including the use of co-medicals, applications to nursing care, and enabling information sharing between doctors on the medical team. For telemedicine to be used in home care, it would be desirable to expand the range of its application beyond examination. Doing so would require an examination of problems that telemedicine has not had thus far, such as surveying the modes of operation in nursing and the like, or examining billing in long-term care compensation plans.

4) Development processes in Niimi City

Because work has begun in developing a broadband communications infrastructure, much effort has been put into the challenges of non-healthcare matters, such as the “last mile” problems, and developing videoconferencing equipment. These may have settled temporarily, but there is no shortage of problems that have not been solved, including the patient burden of communication costs and addressing the increased burden associated with telemedicine. There has also been basic research for nurses to participate in telemedicine, steadily taking the necessary steps, such as launching a research community in regions, including educational institutions of nurse training, and ICT operators.

6. Summary

An overview of home telemedicine in rulal areas has been provided. Home telemedicine should be further investigated as an effective means for regions underserved by doctors.

4.6 Telenursing

Tomoko Kamei
St. Luke's College of Nursing

1. Introduction

Japan has become predominantly an ultra-elderly society, where increasing number of patients are receiving home care services for chronic diseases. In order to support persons who are receiving home care services, progress has been made in remote nursing (hereinafter referred to as telenursing) in which a nurse living at a distant place comprehends the health state of the recipient availing home care service and provides disease management.

Telenursing was started in the 1980s in several foreign countries, but its development and practice in Japan has started only a few years ago.

2. Definition of Telenursing

According to the International Council of Nurses, “Telenursing refers to the use of telecommunications technology in nursing to enhance patient care. It involves the use of electromagnetic channels (e.g., wire, radio and optical fiber) to transmit voice, data and video communication signals. It is also defined as distance communication using electrical or optical transmissions, between humans and/or computers.”

Hence, it may be said that telenursing is the provision of nursing care to subjects living at remote places using distance communications technology.

In addition, the functions of telenursing consist of ① daily monitoring of the physical and mental conditions of patients who receive home care services, ② triage of physical and mental status, ③ telementoring, ④ evidence-based nursing and health guidance, and ⑤ coordination and cooperation with specialist personnel.

The monitoring of physical and mental conditions refers to a process in which the patients themselves measure their vital data such as blood pressure, body temperature, and arterial oxygen saturation, and transmit the data to a nurse who can monitor it. Triage of physical and mental conditions is a process in which a telenurse judges whether the condition of a patient has changed or exacerbated, based on which the nurse specifies priorities for responses. Telementoring refers to a process in which a telenurse "gives compassionate advice" as a mentor. However, the necessary nursing and health guidance given by nurses should be based on evidence. In addition, the nurses must cooperate with physicians when signs of exacerbation are observed, and with care managers and others regarding support in everyday life.

The telenurses encourage patients to self-care, and monitor their physical and mental conditions by communicating with them through telecommunications devices.

3. Basic principles of telenursing

Telenurses must abide by the following basic principles because they do not meet patients in person.

1) Relationship between the telenurse and patient
   A relationship based on trust, between the telenurse and patient should be established quickly on commencement of telenursing.
2) Role and responsibility
   The telenurses should have adequate knowledge and skill to support patient needs and make accurate decisions.
3) Privacy and confidentiality
   Telenurses should explain patients regarding privacy and confidentiality before they start telenursing and obtain consent of the patient.
4) Legal aspects
   Telenurses must receive instructions from the attending physician of the patient regarding their duties of "assistance in medical examination and treatment" according to the Public-Health Nurse,

Midwife and Nurse Law. On the other hand, health and nursing consultations with in-home patients with chronic diseases can be considered as "care that accompanies medical treatment." Therefore, telenurses can perform consultations based on clear nursing protocols, regarding provision of care and recording.

Nurses are required to maintain records of the nursing care given to patients and the coordination that was involved with various medical specialists in detail.

4. Evidence for telenursing

The following evidence regarding telenursing is reported from a meta-analysis of "home-monitoring-based telenursing for patients with chronic obstructive pulmonary disease (COPD)."

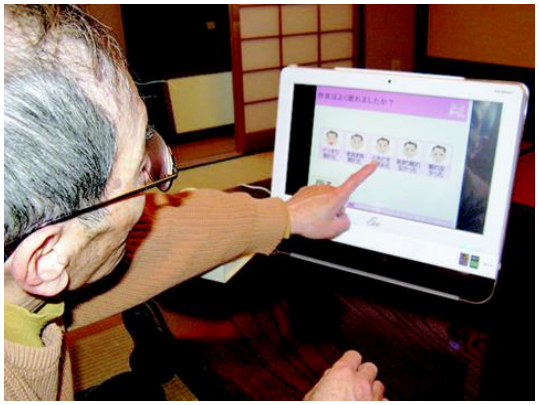
1) Home-monitoring-based telenursing decreases the risk of hospitalization in patients with COPD (Evidence I).
2) It is not clear for how long home-monitoring-based telenursing needs to be implemented to effectively prevent the hospitalization of a patient with COPD. However, 3 to 12 months of telenursing can decrease the hospitalization risk (Evidence II).
3) The home-monitoring-based telenursing decreases the risk of requiring emergency treatment in patients with COPD (Evidence I).
4) The home-monitoring-based telenursing decreases the risk of acute aggravation of the illness in patients with COPD (Evidence II).
5) The home-monitoring-based telenursing decreases the length of hospital stay, which patients with COPD usually require (Evidence III).
6) The home-monitoring-based telenursing does not influence the mortality rate of patients with COPD (Evidence I).
7) The home-monitoring-based telenursing exerts a positive influence on the health-related QOL of patients with COPD (Evidence II).

We provide telenursing by putting the above-mentioned evidence into practical use.

5. Practical examples of telenursing being administered to a patient with COPD

Examples of interview items and answer options for patients with COPD

Self-measurement of blood pressure



Answering the interview items

Providing telenursing

4.7 Telemedicine in Ophthalmology

Akitoshi Yoshida
Asahikawa Med.Univ

1. Introduction

Even prior to the advent of the Internet, the Asahikawa Medical University has been practicing telemedicine since 1994 by making use of information and communication technology (ICT) in order to eliminate the interregional disparity in health care access arising from the uneven distribution of doctors (Table 4.7-1).

The system can be roughly classified into two categories: (1) telemedicine support provided by specialists at the university in the form of diagnosis or therapeutic strategy sent to the regional ophthalmologists and (2) telehome health care support provided by the hospital in the form of follow-up for the discharged patients who are under home health care. Under telemedicine support, depending upon the purpose, the university provides diagnostic support, postoperative management support, and surgical support. Depending upon the urgency, it also provides real-time support and non-real-time support.

This system is used to simultaneously provide "uninterrupted medical support" and impart health education to patients.

2. Telemedicine Support

(1) Diagnostic Support

There are times when ophthalmologists have to judge whether a patient requires medical examination at the university hospital, but simple referrals will place a burden on the patient. Therefore, specialists at the university use the telemedicine support system (Figure 4.7-1) to provide diagnostic support and give guidance on therapeutic strategy based on the real-time eye images of patients sent by the regional medical institutions (Figure 4.7-2).

In the telemedicine support system, images of the situation in the examining room, as well as the slit lamp images, can be shared. A slit lamp is an instrument used to observe the condition of the eye (which is composed of transparent structures such as the cornea, lens, and vitreous humor) by focusing light on it. The doctor at the other side can move the slit lamp in all directions and can change the shape and angle of illumination, as well as the depth and magnification of the microscope, and send the images in real time, thereby enabling the doctor located at a distant area to medically examine the patient on the monitor. Apart from the usual high-definition images, the slit lamp images can also be transmitted as three-dimensional (3D) images.

On the other hand, for cases in which real-time support is not required, or when it is difficult to coordinate the schedules of patients and doctors, non-real-time support is provided through the teleconsultation system (Web system) that is independently developed by the university.

(2) Postoperative Management Support

The patients requiring special postoperative management and continued medical examination until the stable period (e.g., glaucoma patients) are compelled to make long-distance visits to the hospital over a prolonged time, and the heavy temporal and economic burden makes it difficult for them to continue with the medical examination. Therefore, the university has devised a system through which the postoperative management of patients can be carried out at their local medical institutions. The local doctor and operating surgeon at the university share the numerical test data, such as eyesight and intraocular pressure, through the telemedicine network (Figure 4.7-3), and examine the patient and indicate the therapeutic strategy using the telemedicine support system as and when required. This reduces the frequency of patient's visits to the university hospital, and at the same time, maintains a satisfactory

treatment outcome.

(3) Surgical Support

In case of a highly complex operation being conducted at a regional medical institution, the operating surgeon sends to the university real-time images of the eye he/she is observing under the surgical microscope using the telemedicine support system to obtain the opinion of the specialist (Figure4.7- 4).

3. Telehome healthcare Support

Using the telehome healthcare support system that is independently developed by the university, doctors and nurses provide postoperative follow-up and lifestyle guidance to home-care patients after they have been discharged.

The general physical information (body weight, blood pressure, blood sugar levels, etc.) measured by the patient at home is stored in the data center of the hospital through a home terminal at the patient's side, which can be checked anytime by the doctors and nurses from the terminal at the hospital.

Table 4.7-1. Telemedicine in Ophthalmology at the Asahikawa Med. Uni.

Shape		Real-time support	Non-real-time support
Telemedicine support	Diagnostic support (DtoDtoP)	HD images (2D, 3D) sent in real-time	Sharing of numerical test data (eyesight, intraocular pressure, etc.) and eye fundus images
	Postoperative mgt support (DtoDtoP)		
	Surgical support (DtoD)		
Tele-home healthcare support DtoP		Management of general physical information (body weight, blood pressure, blood sugar level, etc.) and advice through TV-telephone	Management of general physical information (body weight, blood pressure, blood sugar level, etc.)

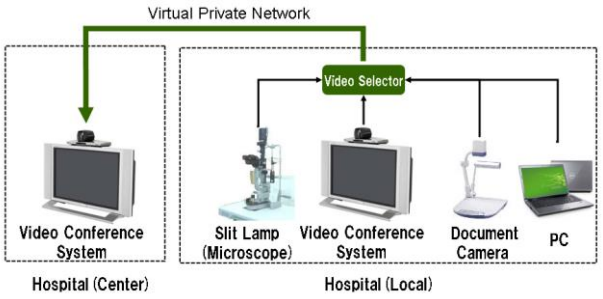


Figure 4.7-1. Basic structure of the telemedicine support system

Figure 4.7-2. Telediagnostic support

In case of any abnormality in the general physical information, the system gives automatic warnings, and the hospital verifies the actual situation by speaking to the patient via the TV-telephone function of the terminal. If there is no Internet connection at the patient's home, a smooth communication with the TV-telephone can be established using a mobile device.

4. Education

The University's Ophthalmology Department also uses the real-time surgical images transmitted from the regional medical institutions for educating its students.

5. Challenges

The telemedicine support system is becoming indispensable in the maintenance and development of community medicine, as it is used not only for the medical examination of patients and for assisting doctors, but can also be applied in wider areas such as the education of doctors and students. However, in order to sustain the operations of this system, the problem of the increased burden on the doctors at the medical institutions providing support must be resolved.

Figure 4.7-3. Sharing of the test results screen
(intraocular pressure)

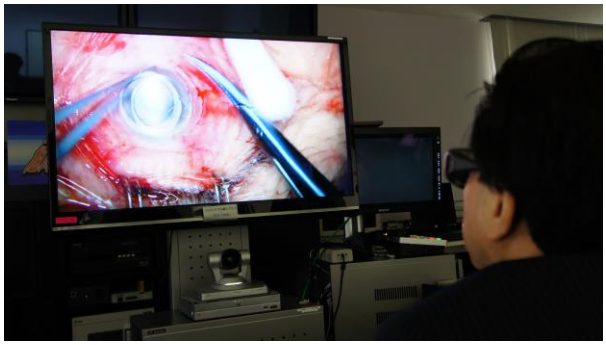


Figure 4.7-4. Telesurgical support
(Overseas 3D high-definition transmission)

In ophthalmology, the support-providing party is paid the medical fee only for the ophthalmological examination done in real-time, which is not sufficient to sustain the system. In order to ensure sustainable operations, there needs to be improvements to the system including a better legal/regulatory framework, which would include incentives for practicing doctors and support for infrastructural development such as equipment and network, among others.

4.8 Mimamori
-Monitoring, Surveillance, and Life support-

Takashi Hasegawa
Gunma University Hospital

1. Introduction

"Mimamori" cannot be explained in simple terms because it has a very wide range of subjects and implementation contents. In other words, Mimamori is not a simple monitoring or surveillance system but a complex one that cannot be expressed easily because it includes concepts such as independence, support, and heuristic observation. We would henceforth refer to it in this document as "Mimamori."

In this article, We have explained the general overview and one of its important components, "Ogenki Hasshin" (the information system that enables one to notify about one's own life condition) that utilizes information communication technology (ICT).

2. Overview of Mimamori

1) Breaking away from misunderstanding

Mimamori is often poorly understood. A typical misunderstanding is to consider the monitoring of vital signs via sensor network as the essence of Mimamori service. Although many technical studies for understanding vital signs in detail are conducted, some of them are not cost effective.

Both monitoring of vital signs and the sensor network system are no more than mere elements of the Mimamori service. There are many issues including the definition of a good Mimamori service, sustainable ways of providing the services, and the assigned position for social security. It is important to design a social scheme and understand the subjects of Mimamori for an effecient implementation of the service. Technology-oriented research and development are not sufficient.

2) Definition and need for Mimamori

・ The word has the following two meanings.

(1) "Watching carefully, and hoping for safety": A preventive measure expecting nil emergency events.
(2) "Vigilantly observing the course of events": This refers to recording the changes that occur over time, and watching the subject from a flexible point of view.

・ Need for Mimamori

(1) Proportion of elderly population has increased due to a prolonged lifespan and lower birthrate. In addition, several people need to be supported even during their youth and middle age due to physical or economic reasons.
(2) Households requiring support are rising not only in depopulated regions of rural areas but also in metropolitan areas. Self-selection of life styles is also increasing, making simple solutions for the above unavailable.
(3) A contemporary issue is to construct a scheme for supporting such people by communities.

・ Burden of sudden change in those who are ordinarily healthy.

The elderly and people requiring life support who are living well ordinarily supported by medical care and welfare services have a weak responsive ability for a sudden disorder, making them feel uneasy. "Prevention before the disorder aggravates" is one of prime concerns of Mimamori.

・ Changes in local communities

Constructing and maintaining communities in which people mutually watch out for each other are difficult in both metropolitan and depopulated regions due to social changes.

・ Increase in the number of people isolated from

support and solitary death

People who consider being supported by others to be a mental burden are increasing. Quite a few people keep themselves away from the society due to economic distress and other reasons. When isolated people requiring support suddenly die or undergo “solitary death” (cases where the body is not found for a long time), it causes mental trauma in the neighborhood residents as well. It becomes problematic for the local administration and is a weakness of residential care.

・ Utility of Mimamori

Finding those before the occurrence of their solitary death is an essential issue in Mimamori. Other important subjects in Mimamori include those facing economic distress, domestic violence, and the prevention of suicide. Mimamori, using a biosensor and a behavior-monitoring sensor, is no less than the final measure. Grasping the statuses by physical services in the early stage often reduces the economic burden and severity. Thus, Mimamori is too pleiotropic to be defined. Hence, not defining it precisely allows Mimamori to be flexible regarding unfavorable events that may occur in future.

3) Viewpoint in social security

It is because the services in social security span across four large fields of health, medical care, general care, and welfare; Mimamori is too wide-ranging to be simply organized. However, a revenue source for social security cannot be defrayed for other fields. For example, reimbursement (use of social security expenses for medical care) cannot be used for general care services.

Those who are engaged in the services also differ depending on the fields. For example, visiting nurses cannot be assigned the responsibility of poor and needy households, nor can they be given authority to manage domestic violence as a part of welfare service in Mimamori. Similarly, welfare-related workers cannot impart medical services on behalf of doctors. Mimamori services are occasionally designed such that they utilize those who are not functionally responsible, only because “they are available.” The services do not become practical unless the operation mechanism of mediation among fields is designed. Moreover, information sharing and cooperation among people in the various fields are important.

4) Conscientiousness of providing Mimamori

Mimamori must not be a service where the subjects are completely dependent on the support from outside with no active participation. Complete support inhibits demonstration of independency in some subjects. People need to live by themselves eventually, hence strong dependency on Mimamori services must not be the outcome, as it may weaken their will to live. Mimamori is not a service that can be implemented by simple automation through machines because it is required to have contents that arouses self-modification in the subject as psychotherapy does. Even though the health field is in close proximity with medical ICT, health promotion and self-modification are said to be essential for health care. In relation to this, We would like to paradoxically add that the comparison of effectiveness between the remote heath management service and health instruction lecture meetings (health promotion) might result in quantitatively disadvantageous remote health management due to the higher cost.

5) Beneficiaries of Mimamori (those requiring Mimamori)

Not only are the elderly individuals and those having an economic or physical problem, but also the following categories of individuals are important in Mimamori.

(1) Subject

(2) Family (in cases where the subject does not

require Mimamori or cannot take a sound decision due to diseases or mental problems)

(3) Community (neighborhood residents, etc.)

(4) Local health and welfare administration

The important point is that we need to recognize that there are instances in which the subjects need to be watched despite his/her rejection, such as prevention of suicide and other cases where the administration bears the cost instead of the subject and the family. It should be recognized that Mimamori subjects who do not desire the service are based in a place different from those of general services.

6) Providers and associated people

Local administration, comprehensive support centers, medical institutions, social welfare councils, welfare commissioners, neighborhood councils, NPO, private business operators, etc. are all conceivable. Providers cannot be simply determined.

3. Cases of Mimamori service

1) Various similar services present in society

It is the elderly emergency call service by private security companies that has a highly integrated system among such services. Services without high integrity include life signs monitoring depending on specific information such as electric equipments and washroom use. There are those that have limited effect as units but exert effectiveness in combination with others. In addition, there is also existence of monitoring by door-to-door visit by volunteers in the areas struck by the Great East Japan Earthquake.

2) "Ogenki Hasshin," existence confirmation with high integrity

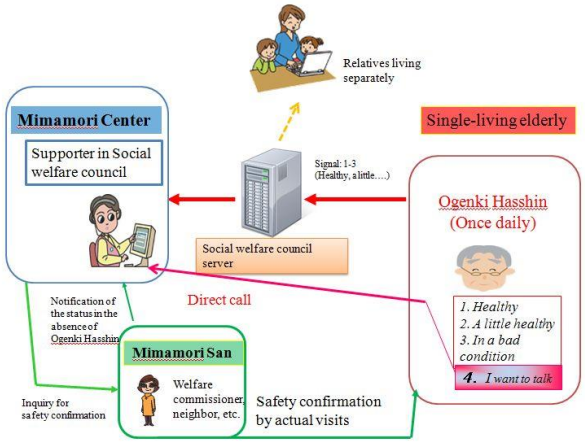


Fig. 4.8-1. Service flow in Ogenki Hasshin

Ogenki Hasshin is a service to confirm wellness of elderly indivuals, etc., which imposes a low burden on subjects and supporters. Ogenki Hasshin is also conducted by arranging the order of social systems. Technically speaking, subjects send a signal to indicate if they are healthy or in a bad condition using a push button of a phone through a telephone line. It needs no special technique and apparatus, and can be operated by social welfare councils, etc. The principle is also simple. Subjects only communicate their conditions using a push button once daily by themselves. Because external people are less involved in it, the subjects have a low mental burden and their spontaneity and independency are preserved. Those subjects in worse conditions can be watched more integrally through the combination of this with other means of Mimamori.

4. Summary

We introduced a part of the functioning of Mimamori in this article. Mimamori is not sufficiently established as a social service because it involves multiple fields. We can expect further development of Mimamori in the future.

4.9 Health Promotion for Local Residents by using the ICT

Sachie Nitta

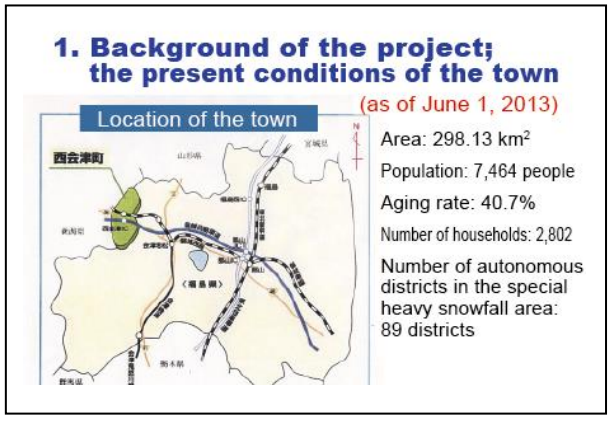
Health Welfare Division of Nishiaizu-machi Town Office in Fukushima Prefecture

1. Introduction

Nishiaizu-machi is located at the prefectural border between the northwest Fukushima prefecture and the Niigata prefecture. The Iide mountain range and the Echigo Mountains are found to the north and the west of this town, respectively. It is an intermontane town where the forest accounts for approximately 86% of the total area of 298.13 km^2. It is also the leading heavy snowfall area in the Fukushima prefecture, with a climate specific to the Japan Sea. The population decreased from 11,249 people in 1985, to 7,897 people in 1991. The aging rate changed from 18.72% (1985) to 39.8% (as of October 2011).

Since 1996, as a part of a special project for community health promotion by the Ministry of Health, Labour and Welfare, the "Home Healthcare Support System" was launched with the NTT network, using information and communication technology (ICT). This system has been implemented, using the cable television (CATV), networks since 2005. A total of 680 terminals were used until fiscal year 1995.

Considering the current terminals will become unavailable as an optical communication line is established, 260 new terminals are being used in this project.



2. Purpose of the project

Nishiaizu-machi is a heavy snowfall area, and villages are widely interspersed within this town. As a result of the geographical environment, it takes approximately an hour by car for the inhabitants of distant villages to commute to the center of the town. Thus, it was very difficult to provide health guidance throughout the town. Focusing on the "Home Healthcare Support System" using ICT, the project mainly supported inhabitants of Nishiaizu-machi who were at a high risk, identified using blood pressure management, which is important to prevent and control lifestyle-related diseases, such as stroke, heart disease, and diabetes in particular.

3. Outline of the project

After the CATV-integrated information system was established across the town, and the "Nishiaizu CATV broadcast center" was set up, 97.3% of the households have subscribed and become completely interactive. This system was introduced on April 2010 and initiated on July 2010 as a part of the "grant-in-aid project for utilization of local ICT," established in 1991 by the Ministry of Internal Affairs and Communications. Furthermore, it has been able to rapidly gather a considerable amount of information.

The names of the community health nurses who confirmed the information of the inhabitants to be supported by this system are registered to be readable with three PCs at the same time. The terminals can be installed and removed by a designated administrator in the town. For the users who did not use the terminal for one month, health guidance was

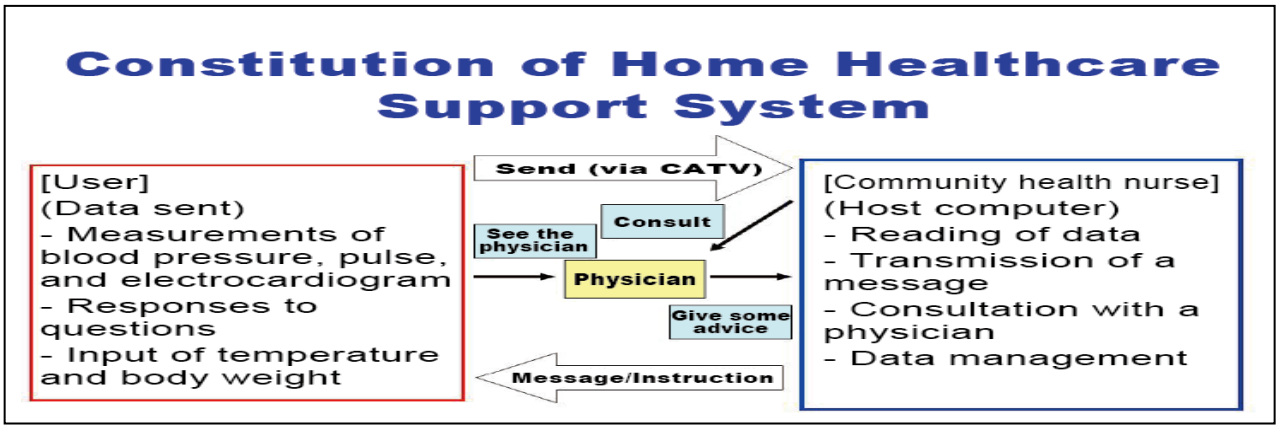
provided. For the users who did not use the terminal for three months, individual health guidance was provided in visitation. Thus, 260 terminals have been used effectively.

In this project, four persons per terminal can receive instructions from physicians and community health nurses at home. The health data, which are input by a user, are automatically transmitted to a host computer.

The community health nurses make comments every day and the users report their individual daily life. The data for one month are confirmed by a monthly report, which provides each user's lifestyle information. All of these services are free for users.

Figure 4.9-1. Blood pressure measurement

Figure 4.9-2. Electrocardiogram measurement



4. Implementation and evaluation of the project

The sex and age of the users as of April 2013 are as follows: for men, 53.6%, mean age of 62.8 ± 12 years; for women, 46.4%, mean age of 67.5 ± 28 years. At this time, those are as follows: for men, 53.6%, mean age of 64.9 ± 28 years; for women, 47.6%, mean age of 66.8 ± 28 years. These data indicate that this service has been used by inhabitants in various age groups. Community health nurses read an average of 101 and 1,906 cases per day and per month, respectively. The number of uses in 2012 was 8.3 times a month.

To promote the use of the terminals and to support the users' improvement of living, the community health nurses perform the following services: (1) deduce the circumstances of the subject by telephone and give advice when changes in the data (blood pressure, pulse, electrocardiogram, temperature, body weight, and steps) are found; (2) make instructive comments in a monthly report and prepare additional individual data, which are brought to visits with the attending physicians by each subject, to be referred to by them; (3) talk to the users twice a month, even if their data were stable.

As a result, the questionnaire survey (collected from 227 users [collection rate 78.5%]) showed the satisfaction of this project was as follows: 61 people (26.9%) were extremely satisfied and 118 people (52.0%) were fairly satisfied.

5. Conclusion

In Nishiaizu-machi, depopulation and aging have rapidly progressed. Using the extensive data of the Home Healthcare Support System, and providing health guidance through visitations or meetings, we actively provide instruction, allowing inhabitants to do treat themselves. However, although the operation has become simple, because the terminals were changed, the users have complained of difficulties associated with the operation, or have reported that it is difficult to learn the operations. We will give ongoing lectures about operational procedures, create an inhabitants group, and will hold a meeting to teach the procedures.

In Nishiaizu-machi, various conventional measures for health have been taken, which showed positive results from the aspects of mean lifespan data or others. However, the goal should not only be to live long, but also to extend a healthy lifespan and to improve the quality of life; this should be enhanced to support a healthy and independent life from a young age. It is especially desirable to use these measures to promote the health of people who are potential leaders and, who may contribute to a lively and active region, even in an aging society.

In the Home Healthcare Support System, using the data of ICT after introducing the system, the staff has been assembled to be in charge of supporting the user's life (e.g., the community health nurse, registered dietitian, daily eating habit improvement officer, and health movement promotion officer). In future, by advocating "Health is best," we will support the inhabitant's health care.

4.10 Collaboration Network for Heavy Ion Cancer Therapy

Kota Torikai

GUNMA Univ

4.11 Community Healthcare Coordination

Masayuki Honda
Nagasaki University Graduate School of Biomedical Sciences

1. Introduction

The concept of wide-area medical information systems can be broadly divided into telemedicine systems and community healthcare coordination systems. This section defines various types of medical information services (other than radiology and pathology related services, such as teleradiology and telepathology) delivered via networks of community healthcare coordination systems, and provides an overview and explanation of the current situation regarding the deployment of such systems. Medical information systems started mainly in large hospitals, such as university-affiliated hospitals, with systems such as medical business accounting systems. Following that, departmental systems (such as lab test systems, pharmaceutical department systems, radiology department systems, hospital catering and nutritional management department systems, and nursing systems), and ordering systems that linked medical treatment departments with central diagnostic and treatment departments gradually came into operation. In 1999, prompted by a notification from the Ministry of Health and Welfare regarding storing medical records on electronic media, electronic medical charts were introduced, mainly at large hospitals, and made the medical chart an electronic part of patient medical records (the so-called “"form two”). Subsequently, this progressed to digitalization at core hospitals, such as city hospitals, and “community healthcare coordination systems” also became operational in the regions. A number of these systems in deployment can be cited as successful examples, and are described later in this section by way of illustration.

2. Two Key Themes for Government

In recent years, two themes, the “My Hospital Anywhere” concept and “Achieving Seamless Community Healthcare Coordination” have been taken up by government departments such as the Ministry of Internal Affairs and Communications, the Ministry of Health, Labour and Welfare, and the Ministry of Economy, Trade and Industry, and are being examined by taskforces. The “My Hospital Anywhere” concept is positioned as a service that makes it possible for an individual to receive individualized medical and health information from the medical institutions that choose to provide it, and electronically manage and use this data personally. Individual participation type disease management services, such as an electronic-version of the diabetes coordination health record book, are examples of such services. On the subject of “Achieving Seamless Community Healthcare Coordination,” the goal of building systems that make seamless data-sharing possible between institutions involved in community healthcare, from medical treatment to nursing, has been identified. Additionally, an investigation is underway as to how incentives aimed at using IT to prevent diseases worsening should work, and to identify the specific architecture that regional councils should refer to when building information coordination systems. When pursuing either of these subjects, it is essential to explore the realization form in a way that factors in the actual situation out in the field that is in each region. In fact, the community

healthcare coordination systems that are currently being deployed in the regions are a concrete approach designed to achieve the goals of these two themes.

3. Expectations for a National Identification Number System in the Medical Field

The Social Security and Tax Number System (My Number) Act was enacted in May 2013, and determined that social welfare and tax payment will be managed using one personal identification number. However, it is undecided if this will be used for medical information. Currently, in the community healthcare coordination systems being deployed in the various regions, patient identification uses NEC/SEC's ID-LINK and Fujitsu's Human Bridge systems. Potentially, using this national identification number system in the medical field would make the centralized management of patient IDs possible, which would drive progress in community healthcare coordination. However, circumstances are complicated by the current Act on the Protection of Personal Information Held by Administrative Organs, which prevents the collection and use of patient information. However, a specific act pertaining to the medical field is under consideration. Such an act will drive big data projects, such as the NDB(National Database), and regional data banks, encouraging the effective use of accumulated data. Furthermore, the use of a national identification number should be promoted based on a specific act to become effective .

4. Community Healthcare Coordination Systems

Building community healthcare coordination network systems using information and communications technology (ICT) has been part of Japan's information technology strategy, thus far, driven by subsidies and other funding from the government. However, because of the problem of securing operating costs and establishing operational systems, many projects have been unable to continue operation. In community healthcare coordination, historically, many failed examples have been seen. However, there are also some examples of systems that have succeeded and are expanding the scale of their operations. A number of such examples are introduced below and, in order to be able to ensure continued operation, the following factors are considered: cost reduction (setting the participation and operational expenses for the participating medical institutions appropriately, reducing the financial burden of system-rebuilding costs); awareness of the significance of the project in the community; and building the human networks of participating members.

4.1 Net4U

The initiative run by the Tsuruoka Medical Association in the Yamagata Prefecture is called Net4U (commenced in 2002). The 4U (Units) refers to the four units in the network: hospitals, clinics, home-visit nursing stations, and testing centers, which are connected in an ASP(Application Service Provider)-type electronic medical chart network. The medical information that can be accessed includes diagnosis, prescription, injections, imaging, various findings and observations, test results, and electronic documents such as physician's records, nurse's records, request forms, and reports, covering all of the information required for medical-care coordination. As the introduction of this network was a medical association-led initiative, its salient feature is that it is used for coordinating medical care (between clinics) and home healthcare.

4.2 Wakashio Medical Network

This initiative (commenced in 2001) connects and shares patient information between clinics, healthcare centers, dispensing pharmacies, and home-visit nursing stations, operating around the core Chiba Prefectural Togane Hospital in the Sanbu Medical District. This initiative allows shared access within the district to an ASP medical treatment support system, linked to the electronic medical charts of Chiba Prefectural Togane Hospital, allowing other medical organizations to view and enter information stored at Chiba Prefectural Togane Hospital, including basic patient data, physical examination findings, referrals, prescription details, laboratory test data, and image data (CTs, endoscopy, ultrasound, plain radiographs, and electrocardiograms). The salient feature of this system is the fact that it aims to improve the quality of diabetes treatment across the entire district through the close collaboration between specialists at the Chiba Prefectural Togane Hospital and physicians based at local clinics.

4.3 K-MIX (Kagawa telemedicine network)

K-MIX (Kagawa Medical Internet eXchange) was initiated in 2003 when a remote diagnosis system server was installed in a data center. As this system developed from remote image diagnosis, it was mainly focused on uploading images and remote image diagnosis or consultations by specialists. However, it is expanding and currently covers patient referral documents, electronic prescription information, and community coordination critical pathways. In 2006, automatic linkage of XML (J-MIX) electronic medical charts and the data center server was incorporated into the system.

4.4 Ajisai Network

The Ajisai Network is one of the largest community healthcare networks in Japan, allowing medical information from 21 major hospitals in the Nagasaki Prefecture to be used, with the patient's consent, by 200 medical organizations. This network commenced operation in October 2004, and is used in regional clinical settings, covering a total of 22,350 patients (as at July 15, 2013), with just under 500 new sets of patient information being added and shared each month.

The salient features of this network are the fact that all of the medical information the hospital permits can be used, and that the system is maintained using the revenue from user membership dues alone. In 2009, the City of Nagasaki, the largest city in Nagasaki Prefecture (population approximately 450,000), joined the network. The Sasebo district joined in the 2012, thus, completing the network to cover the entire Nagasaki Prefecture. Until now, the network was primarily used by physicians based at local clinics involved in coordinated healthcare, to view hospital medical charts. However, pharmaceutical coordination (allied pharmacists becoming members of the network has made supervised administration and instructions on the use of medications possible at dispensing pharmacies), deployment in home healthcare, and inter-hospital coordination (seamless information sharing between hospitals on the core hospital side) has also commenced. Additionally, the Ajisai Network is regarded as a high-security network platform specializing in medical treatment and welfare, with a remote islands medical support system and remote image diagnosis system, and is commencing operations in April 2013. The introduction of a perinatal period support system, video conferencing system, remote lifelong education system, and chronic disease management system is planned in future (Figure 4.11-1).

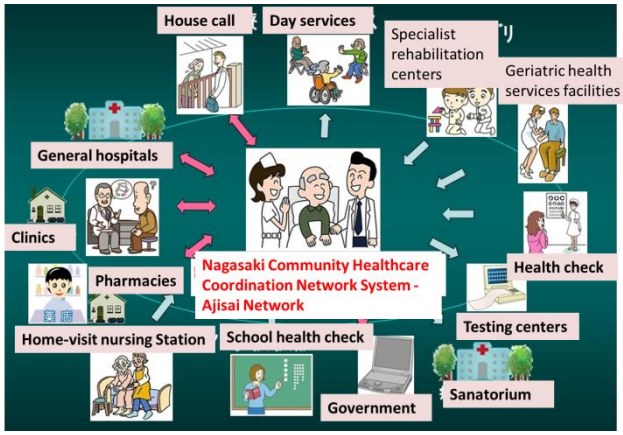


Figure 4.11-1 Coordination between Medical, Nursing, Welfare, Government, & Education

5. Conclusion

A number of examples have been used to give an overview of the existing situation regarding community healthcare coordination. It is of paramount importance that such successful examples be used as references to design models in Japan, and that each local region works towards standardized services and self-contained community medical systems. The issue that arises in doing so is the appropriate handling and use of personal information in the medical field. In addition, while we should aim to deploy a variety of services rooted in the community and improve the quality of medical treatment, it is necessary for medical organizations to raise the base level of information security to a certain level in light of the spirit of Information Security Management Systems (ISMS).

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4.12 Mobile Telemedicine System

Mobile Telemedicine System

Takeshi Takahashi
National Hospital Organization Kumamoto Medical Center

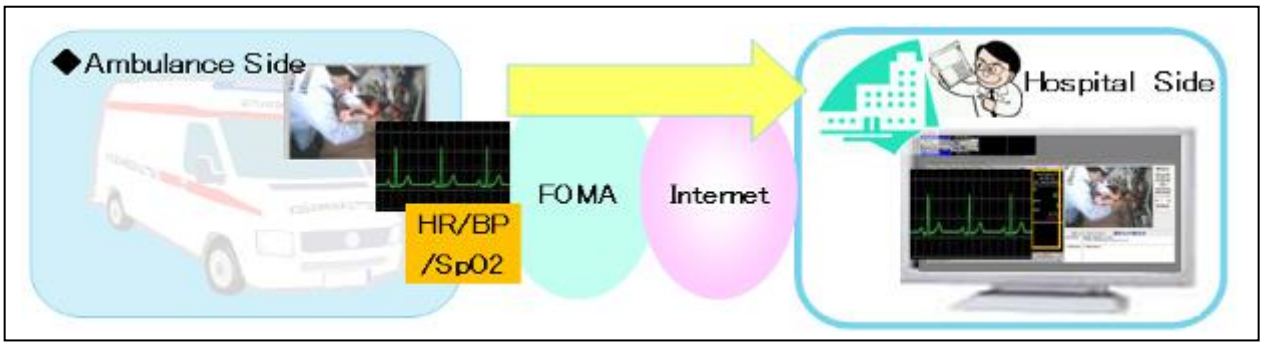

Figure 4.12-1 Schematic diagram of the mobile telemedicine system

1. Introduction

Mobile telemedicine systems can be used to report a patient's condition to a medical institution in real time while the patient is being transported in an ambulance. This facilitates sharing accurate information between doctors and the emergency team, and can improve lifesaving endeavors such as lifesaving treatments and gathering staff and treatment preparations at the hospital prior to arrival.

2. Outline of the system

Figure 4.12-1 schematically illustrates this system. In this system, an ambulance sends information regarding a patient's vital signs such as blood pressure, heart rate, blood oxygen concentration (SpO2), electrocardiogram (ECG), and images from the ambulance's camera to the destination hospital in real-time using cellular telephone lines (FOMA) or the Internet.

3. Basic structure of the system

This system consists of a transmission system installed in the ambulance, a receiving client at the hospital, and a relay server that links them both.

It has the following characteristics:

1. The hospital can assess the conditions of patients simultaneously in multiple ambulances.
2. Multiple hospitals can receive information from one ambulance, making regional medical cooperation possible.
3. The information on vital signs, ECG, and images are transmitted by a single cellular telephone line.
4. The same ECG waveforms can be displayed in both a hospital and an ambulance by transmitting the electrocardiogram information as data.
5. The information can be received by a general-purpose personal computer without an exclusive receiving terminal.

4. Transmission system

The transmission system consists of ①transmission device, ②controller, ③base camera, ④handy camera, and ⑤ECG. Figure 4.12-2 displays its configuration.

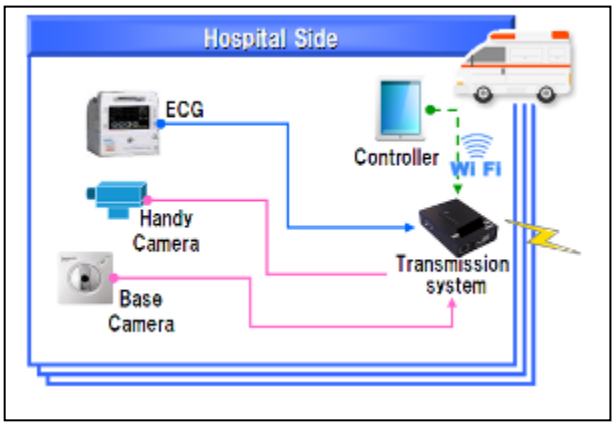

Figure 4.12-2　Configuration of the transmission system

① Transmission device

It encrypts the information that is received from an ECG and camera, and transmits the encrypted information to the receiving system in a hospital through a cellular telephone line.

In case of interruption in transmission due to poor signal at some location, the transmitting side will get reconnected automatically and resume transmission.

② Controller

It connects/disconnects the ambulance with the hospital selected as the destination. During transmission, doctors in the hospital can view and interpret images that are displayed on the screen of the controller from the camera in the ambulance. Furthermore, it notifies the transmission status with a status lamp.

③ Base camera

It is a camera that is installed in an ambulance at a fixed position. It is usually installed in the rear on the ceiling.

A doctor at the hospital that is receiving the image can maneuver the camera.

④ Handy camera

It can show images from any position and is not fixed inside the ambulance. It can take close-up images of areas that are difficult to view from the base camera, such as that of an affected part.

⑤ ECG

It transmits the 12-lead ECG information and vital signs of a patient to the transmission device.

The receiving client can receive information by logging into the relay server from a general-purpose PC. Figure 4.12-3 shows the standby screen image.

Figure 4.12-3　Standby display

When transmission of information from an ambulance is commenced, the information is displayed in the sub-windows on the upper part of the screen. When multiple ambulances transmit information simultaneously, multiple sub-windows will display their respective information. Figure 4.12-4 shows a screen image during connection.

Figure 4.12-4　Sub-windows

When an ambulance is approaching a medical institution where a viewer is watching the screen, the information of the patient will be displayed automatically. Figure 4.12-5 shows the screen image.

Figure 4.12-5　Screen image during transmission.

Figure 4.12-6　Screen image during transmission.

The images from the fixed camera can be manipulated by the recipient. One of the two cameras can be used by switching as required.

When transmission is complete, the images of patient information will disappear automatically and the sub-windows will return to the standby display.

The relay server receives the information from the transmission system of the ambulance and then appropriately transmits it to the receiving client in the hospital. Server relays enable the system to be used without being dependent on any particular receiving client.

We believe that this system can improve the accuracy of understanding between the doctors in hospitals and emergency crew teams, thus improving life-saving services.

4.13 Telemedicine and International Medical Cooperation

Naoki Nakashima, Shuji Shimizu
Telemedicine Development Center of Asia (TEMDEC), Kyushu University Hospital

1. Introduction

When international activities for telemedicine are taken into consideration, various possibilities and some limitations may present themselves. “Medical practice” is commonly performed in the country where a patient lives, not in a country where the physician is. Consequently, although some countries permit a certain exception regarding medical services, unlicensed healthcare practitioners cannot provide remote medical services.

However, this does not mean that telemedicine is incompatible with international medical cooperation. Telemedicine has many possibilities, including future deregulation, and will be promoted. For the 18th International Society for Telemedicine & eHealth (ISfTeH) International Conference of 2013, international medical cooperation sessions are planned.

In this section, we discuss our international remote activities over approximately ten years, to investigate future possibilities.

2. Telemedical Development Center (TEMDEC) of Asia

2-1 Process and results of the activities

The telemedicine activities initiated in 2003 have been conducted by the Kyushu University Hospital for 10 years, in the following ways: through participation in the Asia Pacific Advanced Network (APAN) (2004); establishment of the APAN medical care working group (2005); establishment of the "Telemedicine Development Center of Asia" as a central medical facility of the Kyushu University Hospital (2008); and implementation of the special project of the Ministry of Education, Culture, Sports, Science and Technology (2010–2015 fiscal year).

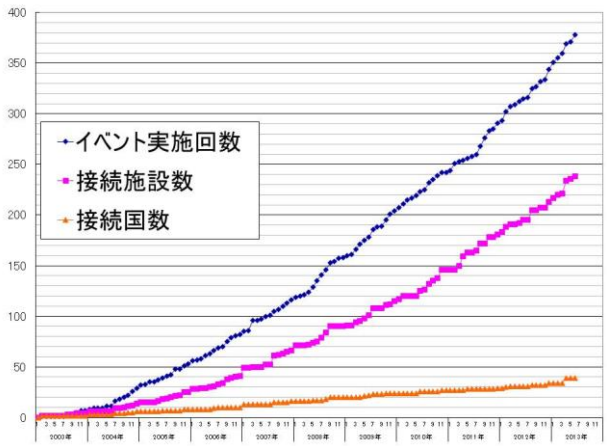

Figure 4.13-1. TEMDEC's activity results for 10 years

To date, the TEMDEC provided the connection for 238 institutions in 39 countries and achieved 378 events. Of these connected institutions, 69 institutions were located in Japan, which indicated the network has also been established in Japan (as of the end of June 2013).

The goal of these activities is to be able to participate in the interactive delivery of high-quality videos, globally, using a scientific research network. The absence of system installation costs encourages participation from developing countries.

Table 4.13-1. Main activities of the TEMDEC

1. Introduction of advanced surgeries/medical procedures
2. International conferences regarding infection, health care, medical service systems, etc.
3. Statements and meetings for health care professionals, excluding physicians
4. Student education or interactive student conferences
5. Remote attendance at scientific societies/lectures given remotely
6. Trial of international or overseas remote medical services/consultation

As shown in Table 4.13-1, the TEMDEC has thus far functioned mainly as a telemedicine education system and information-sharing system. These systems have provided a place to mutually share useful information for participating countries, rather than deliver information exclusively from Japan or other developed countries to developing countries; Japan has also received much information and stimulation. Recently, it the decline of an internationally oriented view has become a concern; the number of Japanese physicians and researchers who study abroad has decreased. However, in early on-site training sessions for medical students, which were initiated five years ago as an activity of the TEMDEC, after having shown a live surgery, the students talked in English with operators or young physicians. This training is favorably received because it promotes the acquisition of English, and stimulates an internationally oriented view.

Figure 4.13-2. Medical engineering class for the second grade students of a medical faculty

Three telemedicine systems are currently used for video transmission, depending on the purpose and institution: (A) H.323 (e.g., Polycom); (B) Digital Video Transport System (DVTS); and (C) Vidyo (Web meeting system). Table 4.13-2 shows the characteristics and comparison. In addition, the meetings at the high-definition HD level have been attempted more than DVTS.

Table 4.13-2. Comparison of telemedicine systems of the TEMEDC

伝送システム	長所	短所
H.323（Polycom, PCS, Tandberg等）	高普及率 操作が容易	高価格
DVTS (Digital Video Transmission System)	フリーソフト 高画質 低遅延	操作が難しい 広帯域が必要
Web会議システム （TEMDECはVidyoを使用）	接続が容易 多地点接続が可能	コンテンツの取扱いが難しい

2-2 Support of the conference activities of the directors of a hospital, in affiliation with a national university

Since 2012, the Kyushu University has been leading the globalization project team of the future image realization working group. Its network and activities are planned to be extended formally to 42 universities and 45 hospitals across the country. In future, physicians and engineers from each university hospital will be elected and the connection to the network will be promoted.

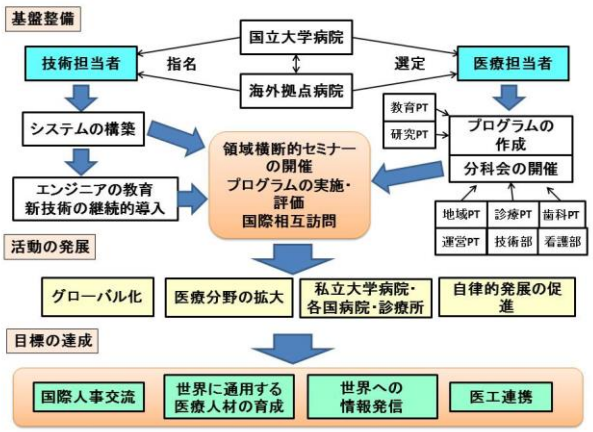

Figure 4.13-3. Promotion policy of globalization project team (PT) and mutual association with other PTs

3. Practical trial of international remote medical services/consultation

As mentioned in the introduction, remote medical services cannot be provided beyond the international border, because of the limitations related to medical licenses. However, telemedicine

consultation and a telemedicine system without medical activity are available.

In the Kyushu University Hospital, the international medical cooperation section was established in 2004, to promote the acceptance of overseas patients and domestic foreign patients, regardless of their nationality. In addition, we asked the National University Society for Medical Cooperation and Discharge Planning to promote international medical exchange. In 2012, we also established the national network office, to accept international patients. Table 4.13-3 shows the potential problems of accepting patients from foreign countries.

Table 4.13-3. Problems associated with the acceptance of patients from foreign countries.

1. Patient has unrealistic expectations from the treatment.
2. Patient visits Japan interpreting his/her own disease excessively, in spite of being adequately treatable in his/her own country.
3. Patient attempts to visit Japan even if patient's condition is too serious to travel.
4. Patient visits Japan with an infection transmissible to other people (obvious risk of infection at airports and in flight).
5. Patient who cannot or will not pay the cost of treatment visits Japan.
6. It is difficult to obtain an interpreter when the patient's native language is rare.
7. There is concern about post-treatment follow-up.

Of these problems, numbers 1 to 6 may frequently occur in foreigners for whom verbal communication is challenging, rather than Japanese living in foreign countries. The TEMDEC will provide a supportive plan to address these problems, as follows: solve problems 1 to 5 by offering telemedicine consultation before visiting Japan; solve problem 6 by providing telemedicine interpretation (i.e., medical interpretation provided from the relevant linguistic region) when a patient undergoes treatment in Japan; solve problem 7 by providing telemedicine consultation after a patient returns to his or her home country. Medical consultation before visiting Japan is conducted using the telemedicine system, while referring to the data on the input screen, which shows patient acceptance on the website (available in Japanese, English, and Chinese). This is prepared by the national network office. Trial experiments have been performed with simulated patients, to prepare for conducting actual telemedicine consultations.

Figure 4.13-4. Telemedicine consultation experiment, discussing to the patient data entered on the website with the cooperation of the simulated patients (living in Wuhan City in China) (February 2013)

5. The promotion of Telemedicine
What is the problem?

Takashi Hasegawa
Gunma University Hospital

1. Outline

The establishment of a foundation in telemedicine is progressing. In addition, information communications technology and medical device technology (such as biometrics) have been sufficiently developed. The remaining issues in the development of telemedicine are medical education, education systems, and the delayed establishment of policy prospects. Additional incidental issues include the delayed creation of prospects for experts in society and the confounding of medical policy with industrial policy.

Efforts to develop telemedicine in Japan began in earnest the early 1990s. Since then, development has been considered slow, in spite of the industrial world's high expectations. Many subsidies have been allocated to telemedicine, and research has progressed. However, telemedicine has experienced unnecessary challenges, such as development progressing slower than expected, or the call for regulations to be eased. There is also some criticism of the lack of clear results, despite the large amounts of subsidies.

Internationally, Japan is viewed as having good medical care standards and access, but seems to have little need for telemedicine because of its small size. However, such international comparisons are not necessarily meaningful. Japan needs telemedicine, despite being a small country. I would like to see telemedicine placed firmly among the medical care services provided in Japan, and I would like to create prospects for techniques to develop it as a form of medicine.

2. The Lack of Policy Promotion

Telemedicine is a means of relieving doctor shortages and the uneven regional distribution of medical services. Using information communications technology, telemedicine streamlines the provision of medical care and mitigates relevant problems. However, the majority of policy discussions have focused on public medical insurance. Although such discussion is important, in terms of methods of maintaining telemedicine, there has not been enough discussion of other issues, such as what telemedicine can do, what benefits it has, and how it is useful in society.
The Ministry of Health, Labour and Welfare, which is responsible for dealing with telemedicine in terms of the framework of the health care system, has not yet formed a comprehensive system for providing healthcare in during doctor shortages. "Doctors just need to make visits" continues to be a common conception.

Other government ministries often consider telemedicine to be part of industrial policy. There are expectations of significant markets for image communications devices, information devices, wireless communications, and broadband communications. Some have also turned their attention towards regional development measures. Unless telemedicine is established as a healthcare system, it will be difficult for industrial policies and regional development measures to be affected. Making telemedicine devices widely available in electronics retail stores, allowing doctors and patients to purchase them freely, has failed to advance telemedicine. Because healthcare policies are strict, some believe that further easing

restrictions would advance telemedicine. However, what is required is not the easing of restrictions, which could be harmful to functioning medical policy, but the establishment of a system.

Although it is claimed that telemedicine has not developed, national statistics have, in fact, not ascertained the number of times telemedicine has been used. The lack of accurate information necessary for drafting policies presents a major challenge to moving forward. Considerably more work needs to be done in forming a healthcare policy for telemedicine.

3. Lack of National Health Insurance Fees

National health-insurance fees that were secured for telemedicine in its initial stages are misaligned with health care today. This has become an obstacle to adding new national insurance fees to telemedicine. In addition, progress in establishing national insurance fees is slow because of a lack of evidence, which in turn is attributed to a lack of clinical research (as discussed later). My hope is that developments in clinical research and sociomedical research will improve this situation.

A comprehensive strategy for improving access to health care is also necessary. The direction of society cannot be ascertained simply by researchers asking for national insurance fees for their own research results. I expect that the inherent power of the national insurance system to decide the future of health care will dictate the position of telemedicine.

4. Lack of Clinical Medical Research

The low technological quality and high costs of information communications devices and communications services were major issues in the initial stages of telemedicine. Therefore, engineering research continued to be the driving force of telemedicine. Conversely, clinical research, which would quantitatively verify the efficacy and safety of telemedicine, failed to progress because of insufficient technological standards. Many emphasized “the collection of evidence,” but few were familiar with clinical research design, leading to research conducted under flawed designs. This has, in turn, resulted in a fair amount of confusion, such as research that produced evidence of little value. In the future, telemedicine will require research conducted with techniques that are on par with those used in clinical trials for pharmaceuticals. It is also my hope that clinical researchers in previously uninvolved specialized fields will join the world of telemedicine research.

5. Lack of Sociomedical Research

Sociomedical research involves issues such as national insurance fee mismatches and improving access to medical care. Although these issues differ from those in clinical medicine, they cannot be resolved without specializing in medical care. The minutia of the social security system, health care financing, and the national fee schedule are complex. The addition of inappropriate items to national insurance coverage could hinder the potential development of telemedicine. Quantitative research on the state of medical care access is also important. Although there are doctor shortages, telemedicine needs are not necessarily widely apparent. Access to healthcare could also be improved by alternative means. Research on telemedicine as a means of providing health care, and hospital administration of telemedicine are also issues that merit consideration. However, there is a severe shortage of researchers to investigate such issues.

Medical research comprises three systems: basic medicine, clinical medicine, and social medicine. The need for basic medicine by means of telemedicine has yet to be manifested. However, I would like society as a whole to understand that reinforcing social medicine is as important as reinforcing clinical medicine.

6. Lack of Education Systems

As a direct result of the lack of clinical medical research, telemedicine is not a subject within medical education. It is impossible for young doctors to use medical techniques they have not been taught. It is vital to convey the importance of telemedicine techniques to young people striving to become doctors or nurses, as well as young people in other healthcare professions related to telemedicine.

From this point on, such education will be essential not only for young people who will become doctors and nurses, but also for medical professionals everywhere already engaged in healthcare.

In March 2013, the Japanese Telemedicine and Telecare Association compiled a textbook on techniques for conducting videophone examinations in home care. Further development of projects such as this is desired.

7. Summary

The era of promoting telemedicine with research and development in technological trends, such as broadband communications and computer technology, has ended, and the era of promoting telemedicine with orthodox clinical and sociomedical research has arrived. I would like to promote such knowledge and information to leaders in society.

6. Clinical Guidelines for Telemedicine

Takashi Hasegawa
Gunma University Hospital

1. Background

Clinical guidelines set forth the grounds for diagnosis, treatment, prognosis, and examination, as well as for procedures and applicable targets, in order to provide appropriate medical care in real-world clinical settings. It is desirable for specialized academic societies to publish such guidelines with systematic production. Such guidelines are also important as tools for evidence-based medicine (EBM). From there, the establishment of guidelines is desired in order to ensure the appropriateness of relevant medical practices when adding them to the national health insurance coverage. However, due to a dearth of clinical research related to telemedicine, such guidelines have yet to be fully established.

2. The Necessity of Guidelines in Telemedicine

The main reason that guidelines are essential to the spread of telemedicine is the glaring lack of opportunities for telemedicine instructions. Such instructions are insufficient even at the universities that pursue telemedicine research. As diagnostic imaging methods, teleradiology and telepathology have many techniques in common with hospital procedures, allowing for the accumulation of experience in all medical offices. However, few institutions use videophone examinations in home-based care or perform biometric monitoring, resulting in a near-total absence of opportunities for preparing the instructions. Research and development of techniques are in a difficult situation. Therefore, as information for use in clinical practice, the following types must be disseminated to the doctors who will spearhead telemedicine education: (1) target patients, (2) inapplicable patients, (3) examination techniques, (4) effects, and (5) information related to the verification of safety and efficacy. These types of information are considered the “guidelines.”

3. The Current State of Guidelines

Three telemedicine guidelines have been created by different specialist societies as listed below. In addition, listed is a document that conforms to the said guidelines.

(1) Guidelines for Telecare for Home-Care Patients (Japanese Telemedicine and Telecare Association)
(2) Teleradiology Guidelines (Japan Radiological Society)
(3) Teleradiology Guidelines and Telecytology Guidelines (Japan Telepathology and Virtual Microscopy Society)
(4) Medical Ethics (Telemedicine) (Japan Medical Association; written by the Japanese Telemedicine and Telecare Association)

Guidelines (2) and (3) are the diagnostic guidelines that are not oriented towards specific diseases or treatment methods. Guideline (1) is specific to home-care patients and is not for videophone examinations in general or communications technology. Guideline (4) concerns fundamental issues in telemedicine. Guidelines (1) and (4) will be explained in detail in other items.

On the other hand, no academic society has systematically created guidelines by disease or treatment method. This is due to the lack of progress in telemedicine by site or disease. It is desired that clinical academic societies undertake the creation of telemedicine guidelines accordingly in the future. The creation of such guidelines is expected to lead to the development of a research

that will seek evidence for telemedicine for individual diseases. Such guidelines would also promote the development of social systems such as the national health insurance coverage.

4. Guidelines for Telecare for Home-Care Patients

These guidelines were assembled by the Japanese Telemedicine and Telecare Association and published in March 2011. This was in response to the Ministry of Health, Labour and Welfare's (MHLW) publication of the revised edition of the notice of interpretation of the Medical Practitioners' Law in regard to telecare on March 31, 2011. Even with the publication of this notice from the MHLW, many medical professionals would be unable to take measures without standard techniques for telecare, thus rendering the notice ineffective. Therefore, these guidelines were published to coincide with the MHLW notice.

The main points of these guidelines are shown in Fig. 6-1. Telecare is conducted by videophone between the doctor (clinic) and the patient + visiting nurse (patient's home). The guidelines call for the doctor to alternate between conducting remote examinations and visiting the patient's home. This is based on the results of a research on videophone telecare conducted by the MHLW research grant research team, which has a close relationship with the Japanese Telemedicine and Telecare Association.

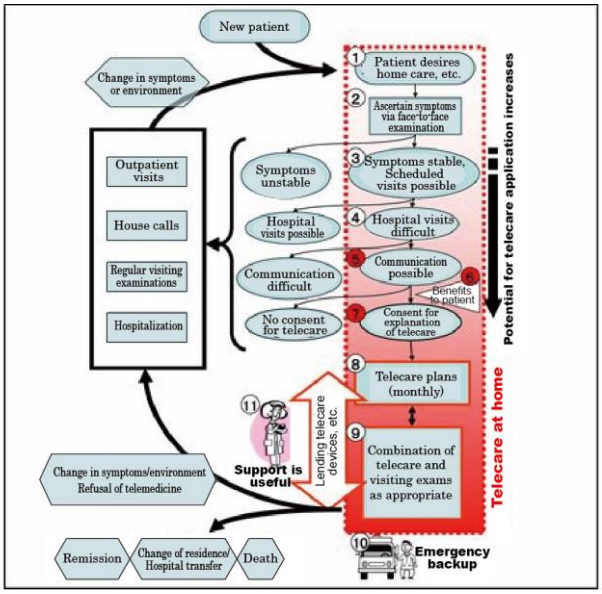

Fig. 6-1 Cycle diagram of main guidelines

In addition to these guidelines, the Japanese Telemedicine and Telecare Association is considering the development of clinical guidelines. However, due to the need to work with specialized clinical societies in creating guidelines by target disease, the Japanese Telemedicine and Telecare Association has set out to strengthen its relationships with such societies.

5. Medical Ethics

Telemedicine is a new method of providing medical care. Therefore, there has been no social establishment of "common knowledge in telemedicine," leading to the risk of unknowingly performing unethical medical practices. One reason for this is the fact that telemedicine is a means of optimization. Although the ability to serve the patients who cannot visit hospitals is a major benefit, there is a possibility of falling into moral hazards such as the patient being prescribed medicine without actually seeing a doctor. While this is a moral issue on the patient's part, the doctor could also fall into the moral hazard of avoiding the patient in order to evade the burden of outpatient care. Prescribing medicine without examining the patient is likely to be dangerous to a large extent.

The mindset of, “Medical care can be provided even if we’re separated or can’t actually see each other” could create many other moral hazards as well.

Telemedicine is also fraught with potential risks. For example, in the research stage, there is a risk of intervention being insufficient or very delayed. The incidence of harmful effects due to telemedicine could destroy people’s trust in telemedicine in the process, thus becoming a major obstacle to its future development.

In order to sound the alarm on these issues, the Japan Medical Association added “telemedicine” as an item in the “medical ethics” section of its homepage in the spring of 2013. Although telemedicine is broad in each specialty, ethical guidelines are the basis of its background.

6. Summary

The establishment of telemedicine guidelines in Japan has only just begun. I would like to promote the establishment of guidelines while simultaneously obtaining evidence for various examination methods.

Secretariat of JTTA

C/O Takasaki University of Health and Welfare
37-1 Nakaooru-Machi, Takasaki, Gunma Pref.
370-0033 Japan
Phone/FAX：+81-27-350-7475
Email：jtta@takasaki-u.ac.jp