Region-based Total Medical Care and Inter-Regional Solutions

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The regional medical network run by "HOPE/Regional Cooperation V1" went live in April 2008 at Asahikawa Red Cross Hospital and in May 2008 at the National Hospital Organization Kanazawa Medical Center, in Japan. This product was recognized by the Japan Industrial Design Promotion Organization as a solution concept for "medical care that integrates the region, thereby providing the patient and family with peace of mind" and won the 2009 Good Design Award. After first touching on the effects of inter-regional solutions on region-based total medical care through the introduction of the HOPE/Regional Cooperation V1 network, this paper describes what is involved in the spread of regional medical networks. Next, it describes the features of the new product HOPE/Regional Cooperation V3 and explains how it addresses a growing need for multiple-access linkage capability. It also mentions the issue of standardization, which is necessary for the spread of multiple-access linkages. Finally, it examines how multiple access linkages will affect regional medical care.

1. Introduction

Starting with the Project for the Promotion of Networking between Medical Institutions based on Advanced Information Technology 2000 implemented by the Ministry of Economy, Trade and Industry of Japan, demonstration projects for building regional medical networks have been conducted nationwide. However, many projects have encountered problems including the difficulty of operating projects after subsidies are discontinued, which shows that building a regional medical network is far from easy. The difficulty of constructing a business model that ensures operating expenses can be met, or providing services that correspond to the expenses paid by individual medical institutions, who are the users, is apparently the biggest factor.

Still, activities for building regional medical networks have become increasingly vigorous in the last few years, indicating that regional medical network building has entered a new phase.

The number of regions that use "HOPE/ Regional Cooperation," Fujitsu's regional medical network package, to build a regional medical network amounts to 13 as of June 2010.note 1)

This paper first mentions the benefits of regional medical networks that have become even clearer in the course of actually operating HOPE/Regional Cooperation and what issues are to be tackled to spread regional medical networks. Next, it describes the features of HOPE/Regional

note 1) HOPE/Regional Cooperation has a regional cooperation office basic function that assists with the operations of a regional cooperation office and a medical treatment information provision function that offers services to outside medical institutions, and many customers use the solution only for the former.

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Cooperation V3 that supports *N*-to-*N* multiple access linkages which are in high demand as a new function. With these environmental changes taken into account, the system challenges of regional medical networks are discussed.

2. Points for diffusion identified in case example of introducing HOPE/Regional Cooperation

The regional medical network run by HOPE/Regional Cooperation V1 became active in April 2008 at Asahikawa Red Cross Hospital and in May 2008 at the National Hospital Organization Kanazawa Medical Center. The networks are characterized by the large number of medical institutions including medical offices to which they are connected: about 100 and 46 institutions (as of June 2010) respectively.

Behind this diffusion lies the fact that with HOPE/Regional Cooperation, medical offices with small management bodies can connect to a regional medical network only by paying expenses for putting an Internet connection environment in place, and medical offices that had already been carrying out hospital-clinic cooperation embarked on connecting to the networks in a short time.

As services for regional medical institutions, HOPE/Cooperation is equipped with a medical record viewing function, referral linkage function, online appointment function, regional cooperation clinical path[note 2] function and E-mail function (starting with V2).

Of these, the medical record viewing function is most often used. Configuring information provision settings based on a patient's agreement allows medical records to be viewed by outside medical institutions. The

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note 2) Treatment plans that are created to allow patients to go home soon from acute hospitals through convalescent hospitals and shared among all medical institutions that give treatment.

benefits of viewing medical records via a regional medical network include:

1) Benefits for medical office doctors
- Checking the content of treatment and care processes of a referred patient with the attending doctor on the phone is not easy, but the system allows a doctor at the medical office to read medical records at the hospital whenever it is convenient for the medical office doctor to do so. For patients that need special attention, their progress can be frequently checked starting immediately after they are referred.
- As outpatient care at a medical office following treatment at a center hospital, patients' conditions at the time of discharge (examination images and results) and treatment processes can be explained to the patients or their families while viewing the medical records kept at the hospital.

2) Benefits for rehabilitation hospital doctors
- The doctor in the institution to which the patient has been transferred knows the full background of the patient. It is impossible to gain an understanding of everything through exchanging letters including referrals, but this system makes it possible.
- Learning about referred patients before they are transferred becomes possible. For example, there is no need to go to the trouble of interviewing patients to ask them about their physical conditions after an operation, and treatment can be given more smoothly.

3) Benefits for center hospital doctors
- When patients are transferred, telling them that the doctor they are referred to can view their medical records at the center hospital can give them peace of mind.
- For the doctor, the burden of preparing documents to provide information about treatment at the time of transfer can be reduced.

Promoting functional specialization and mutual cooperation among medical institutions
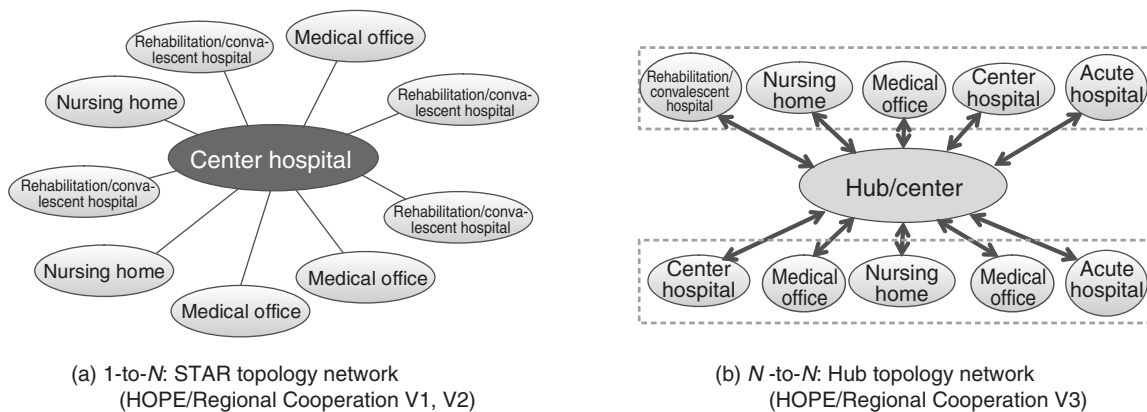
(a) 1-to-*N*: STAR topology network
(HOPE/Regional Cooperation V1, V2)

(b) *N*-to-*N*: Hub topology network
(HOPE/Regional Cooperation V3)

Figure 1
Configuration of regional healthcare network.

is at the heart of the government's medical system reform. Thus, the system is shifting from hospital-based total medical care that completes treating a disease at a hospital, to region-based total medical care in which medical services are provided as a whole region. In the process, treatment information must be shared so that multiple medical institutions can look after a patient and the medical record viewing function is an indispensable tool for this purpose.

In the past case examples of building other regional medical network systems, some had a function that allowed prescriptions, examination results and images to be shared. To improve the quality of medical services in region-based total medical care, we believe that information such as doctors' judgments and treatment policies must be shared as well.

In the case examples of HOPE/Regional Cooperation mentioned above, information about more than 8000 patients is annually shared via this system. This figure is very large compared with those announced in the past demonstration projects, and this indicates the usefulness of the medical record viewing function.

Through environmental changes including the diffusion of the patient-centered concept and region-based total medical care, the benefits for users as described earlier and the requirements for increasing the number of users are becoming

clear. This has led to an increase in the number of customers who decide to build a regional medical network.

3. HOPE/Regional Cooperation V3
3.1 Background of development

HOPE/Regional Cooperation V1 and its functionally enhanced version V2 take the form of a 1-to-*N* (STAR) topology that provides information stored at the center hospital to medical institutions in the vicinity [**Figure 1 (a)**].

There are two reasons for adopting this 1-to-*N* topology. One is that front cooperation[note 3] and rear cooperation[note 4] between acute hospitals (with general beds) that play the central role, and medical offices and chronic hospitals (with convalescent beds) account for a large portion of the overall cooperation believed to be required in regional medical networks. The other is that the 1-to-*N* topology has a benefit that it can be introduced in a short time on the initiative of center medical institutions that provide services.

However, functional specialization and cooperation between medical institutions have

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note 3)   Referring or transferring a patient from a medical office to a hospital that provides advanced medical care.

note 4)   Transferring a patient in apparent convalescence from a hospital to a medical office or rehabilitation hospital.

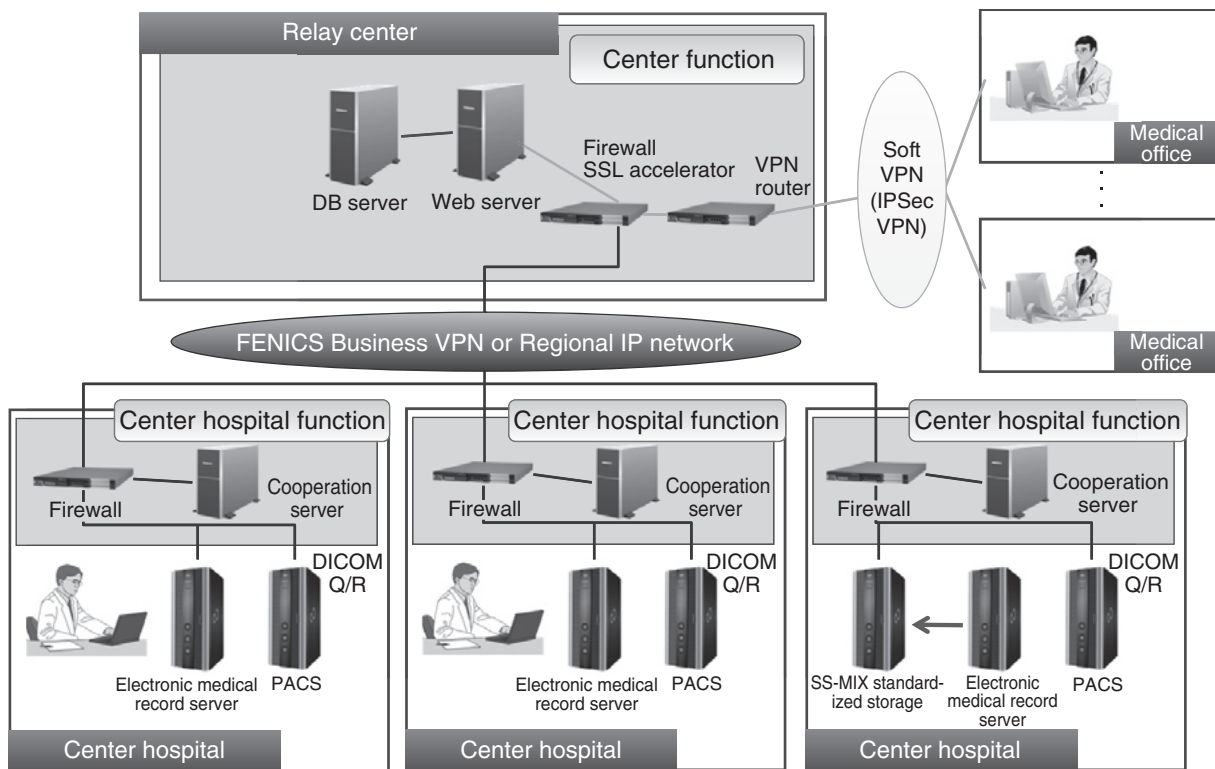FUJITSU Sci. Tech. J., Vol. 47, No. 1 (January 2011)

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Figure 2
Example configuration of HOPE/Regional Cooperation V3.

become in even higher demand due to the lack of doctors in recent years, and this has given rise to new needs that cannot be addressed with the 1-to-*N* topology. For example, there are cases in which center hospitals of a similar scale have different strengths and weaknesses depending on the diseases they treat and acute hospitals mutually refer patients to each other according to the disease. In such cases, one center hospital alone is often unable to sufficiently operate the emergency medical service system and neighboring center hospitals mutually complement each other to offer a better system.

In view of these situations, Fujitsu has developed HOPE/Regional Cooperation V3 [**Figure 1 (b)**] with an *N*-to-*N* (hub) topology, which allows multiple medical institutions to mutually provide information, and offers it.

3.2 Features

A sample system configuration of

HOPE/Regional Cooperation V3 is shown in **Figure 2**. The system consists of a center function that collects information from medical institutions based on patient-ID-linking information and medical record publication conditions, and a center hospital function that is deployed at individual medical institutions and retrieves data from electronic medical records.

The relay center and individual medical institutions that provide services are connected via the FENICS[note 5] Business VPN (VPN protocol: IPSec) (or by making use of an existing regional IP network, etc.) to guarantee network security.

Medical offices and small hospitals that do not provide information about medical records can install VPN connection software to connect to this network as required, and thereby gain access free of charge except for the Internet connection

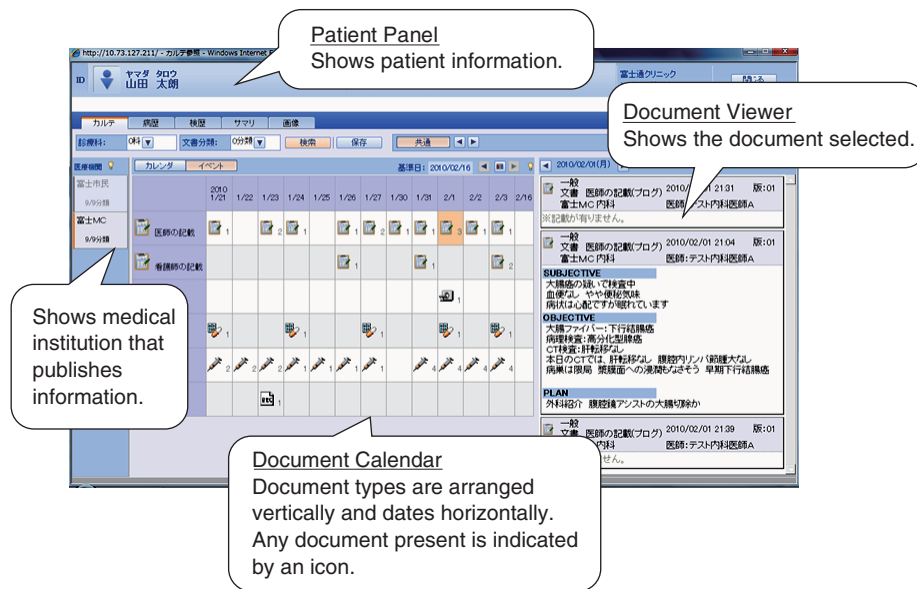note 5)   Generic term for the network services provided by Fujitsu.

Figure 3
Example of screen shown in HOPE/Regional Cooperation V3.

costs.

In addition to viewing medical records, there is an online appointment service that allows medical examination appointments to be booked from outside, a service to exchange referrals online, and a service offering a regional cooperation clinical path. They can be accessed via a Web browser.

Features of HOPE/Regional Cooperation V3 include the following six:

1) Integration of information from multiple hospitals for viewing

The biggest feature of the *N*-to-*N* topology is that information from multiple medical institutions can be integrated (**Figure 3**). This has made it possible to have two-way viewing of medical record information, which was one-way with the 1-to-*N* topology.

The problem of medical records being scattered over individual medical institutions has emerged along with the progress of region-based total medical care. However, this two-way medical record viewing function provides integrated views, allowing patient-centered treatment information for the entire region to be viewed.

2) Connectivity with other vendors' electronic medical records as well as Fujitsu's

Being provided with services from multiple medical institutions means that more than one electronic medical record system adopted by each institution must be handled. HOPE/Regional Cooperation V3 is not only capable of connecting to Fujitsu's electronic medical record system but also to those from other vendors by outputting data to SS-MIX standardized storage.note 6)

3) Image linking mechanism provided as standard function

The need to view images is very high in regional medical care cooperation and connectivity

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note 6) SS-MIX, which stands for "Standardized Structured Medical Information Exchange," is an electronic information exchange program implemented by the Ministry of Health, Labour and Welfare. The standardized storage provides a function of archiving medical treatment information as standardized data.

with PACS[note 7] that supports DICOM Q/R[note 8] is provided as a standard function. The image and regional cooperation servers are integrated to reduce the costs of the entire equipment configuration.

4) On-demand retrieval

The existing HOPE/Regional Cooperation transfers data of patients, who agreed to register their medical treatment information with a database, for publication. With HOPE/Regional Cooperation V3, it has been changed to a system that checks whether or not patients have agreed to register their data when someone attempts to view the data and search medical records on demand.

While the conventional system unavoidably had a time lag between data generation and viewing, the present system achieves completely real-time viewing.

This is to allow the system to be used in more urgent applications including emergencies and is expected to be useful in various situations. For example, when the condition of a patient in the hospital takes a sudden turn for the worse, the attending doctor at home can give instructions to the doctor on duty while viewing the patient's medical records.

5) Support for two patient ID linking systems: regional ID and referral

One major challenge in sharing information in a region is how to link patient IDs that are different between different medical institutions. There are two major linking systems in use:

· Regional IDs

The linking of regional IDs is a system in which patient IDs in a given region are obtained first, and then IDs for the individual medical institutions are linked to them.

This system has the benefit of allowing all information to be viewed once IDs are linked. However, it has problems including the fact that patients must register first, which can be a troublesome process, and the difficulty of controlling the information to be published.

· Referral

With referral linking, the medical institution that provides information permits it to be viewed by medical institutions and users to whom it intends to give the information, and no ID linking is required if the receiver of the information only needs to view the data. This also has the benefit that information to be published can be minutely controlled.

If mutual viewing is required, the receiving medical institution can register its patient ID that corresponds with the patient about whom the information is published.

HOPE/Regional Cooperation V3 supports both of these systems and can thus be operated in accordance with the situations of a given region.

6) System configuration for easy participation by medical offices

The key to success for a regional medical network is to have many medical institutions participate in it and frequently use it. HOPE/Regional Cooperation V3 uses a system configuration in which medical institutions that only need to view medical information and use the referral and appointment services can use the system free of charge as long as they can connect to the Internet.

3.3 Key point in *N*-to-*N* type cooperation: standardization

For *N*-to-*N* type cooperation on the *N*-to-*N* hub topology network, the system must be connected to the systems of other vendors and smooth connection requires standardization. In reality, however, such standardization to allow smooth connection in building regional medical networks is far from adequate, and this poses a major challenge in promoting regional

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note 7)   Abbreviation of picture archiving and communication systems. PACS receives a medical image from a medical appliance with the DICOM sending function.

note 8)   DICOM is a global standard used for storing and sending medical images. Q/R is a query-retrieval service.

medical networks. This section describes the standardization.

Based on the results of a questionnaire given to medical office doctors, the types of information in electronic medical records that need to be viewed the most are the following three:

- Examination results and reports
- Images
- Comments by doctors (diagnostic results, treatment policies, etc.)

Of these, the types of information that are currently standardized enough for utilization are sample examination results and images. Reports and comments by doctors are yet to be sufficiently standardized. We believe that there are also problems including the following:

1) To confirm the consistency between systems, an enormous amount of testing is required for master application, and this makes it difficult to apply the standard master after the start of the system for viewing electronic medical records for regional medical care cooperation.

2) The HL7 V2.5 (HL7: Standards for healthcare and medical information exchange) used for the standardization was originally defined for linking between Hospital Information Systems (HIS) and department systems. Accordingly, it includes items that are unnecessary for regional medical care cooperation, which is primarily intended for information viewing, and places a heavy burden on the supporting side.

3) Standardization specialized in medical treatment content requires expert judgment and takes time before the specification is formulated.

In view of these problems, a standard specification that can display information including data in PDF and HTML format as an external reference should be formulated to cover all medical treatment information in a way that does not require vendors to incur development costs. Then, standard specifications should be individually formulated for the types of information requiring processing in chronological order (such as drug history and examination history) or requiring statistical analysis. We believe this procedure is the most appropriate roadmap for diffusing regional medical networks.

On that point, Fujitsu is actively coordinating vendors' opinions and embarking on standardization through the Japanese Association of Healthcare Information Systems Industry.

4. Future trend of regional medical network

Lastly, we will present the future trend of regional medical networks and explain what HOPE/Regional Cooperation aims to be.

First, the goal of a regional medical network is efficient division of roles between specialists and home doctors, which is also a goal of region-based total medical care.

In the future, this is expected to evolve into a system more specialized according to the disease. For example, there may be a pattern in which rules are established for a disease in a region. Such rules may stipulate that patients with mild symptoms are examined by home doctors, while patients whose examination results exceed given thresholds are automatically referred to specialists. The system needs to support this process.

Sharing expensive medical equipment in a region is also expected to become more popular. In fact, the National Hospital Organization Nagasaki Medical Center, a user of HOPE/Regional Cooperation, has a system in which the Medical Center only conducts examinations such as CT scans, and medical office doctors examine the patients on the same day while viewing images and reports.

In addition, there are likely to be activities such as the establishment of an X-ray interpretation center to effectively manage

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X-ray interpreters and utilize human resources by having X-ray interpreters after childbirth analyze X-rays at home.

With the infrastructure of a regional medical network in place, how hospitals are managed will probably change by making use of the infrastructure. Outsourcing and sharing in a region of unprofitable departments and departments that are not efficient for a hospital to independently manage may well become popular, and in fact more than a few hospital managers are considering such ideas.

Providing a medical information network service infrastructure for realizing these operations and services that are used on the infrastructure is the goal of HOPE/Regional Cooperation.

The movement toward unified IDs assigned to each individual in the country is attracting attention as well. With the existing system of assigning patient IDs in each region, patient ID linking is required, and this has hindered smooth operation. The introduction of a unified ID system will eliminate the need for ID linking and is likely to lead to a significant improvement in the system usage rate and the emergence of new services. Furthermore, services integrating the local government and financial sectors without being restricted to the medical sector so that the entire lives of citizens can be supported may be possible in the future.

Only the Japanese version is available at present but we are working on multilingualization.

5. Conclusion

In this paper, we described the benefits of regional medical networks that have become clearer in the case examples of introducing HOPE/Regional Cooperation, and what is required to have regional medical networks spread. We have also mentioned the development background and features of V3 released for supporting *N*-to-*N*-type cooperation, and noted that standardization is a key point in such cooperation. We then described the anticipated future trend of regional medical networks together with the goal of HOPE/Regional Cooperation.

HOPE/Regional Cooperation, which is based on a solution concept for "medical care that integrates the region, thereby providing the patient and family with peace of mind," has been awarded the 2009 Good Design Award by the Japan Industrial Design Promotion Organization, showing the high hopes placed on it. We intend to capture the ever-changing needs of the medical field and further develop the system as a valuable solution.

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Mr. Tanaka is engaged in development of a cooperation system package for regional medical care.

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