COMPARATIVE ANALYSIS OF REGIONAL MEDICAL INFORMATION SYSTEMS IN JAPAN, THE US, AND THE UK FROM THE VIEW OF EHEALTH ECONOMICS

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Abstract
The regional medical information network connects medical institutions in the region to share residents’ medical data such as images of x-ray and endoscopy, diagnosis, past history of medical treatment, medication, and so on. As a result, it leads to promote efficiency and reduction of medical expenditure by preventing double medical checks or medications. In the age of big data or AI, the network becomes more important. This paper is based on the field research on regional medical information networks in Japan, the US and UK and compares with them in terms of their aims, operation, information systems, and effects to medical institutions, clinics, and residents. Cases compared are Ajisai (hydrangea) Net in Nagasaki, Japan, Healthix in New York, US, and CMC in London, UK. Ajisai Net connects 282 hospitals and clinics in the regions and about 50,000 residents are registered. One of its characteristics is for clinics to access medical data of patients who are transferred to large hospitals to see their real time medical situations. The costs to clinics include initial fees which are JPY 83,000 (USD750) and monthly fees which amount to JPY4,000 (USD36). The network of Healthix connects about 500 medical institutions which share the health records of 16 million residents which include diagnosis, medication, examinations, allergy, and so on. In addition to prevention of double medical examination, or double medication, the network contributes to promotion of efficiency of medicine, and the data accumulated in the network is used for “Population Risk Management” to predict diseases. In London, UK, the network of CMC (Coordinate My Care) also shares medical information of residents and supports care at home. As a result, the aged or patients registered in CMC tend to have fewer emergency calls or hospitalisations than non-registered residents. Based on three field surveys, the paper discusses issues and how to promote the regional medical information network in Japan by considering the roles of the networks in the US and the UK.

Keywords: Ajisai Net; Healthix; CMC; information system; population risk management

Introduction
The regional medical information network connects medical institutions in the region to share residents’ medical records such as images of x-ray and endoscopy, diagnosis, history of medical treatment, medication, and so on. As a result, it promotes the efficiency of providing medical care and the reduction of medical expenditures by preventing double medical checks or medications. In the age of big data or AI, the medical networks become more important in all aspects. This paper is based on field research on regional medical information networks in Japan, the US, and the UK and compares them in terms of their objectives, information systems, economic foundations, and effects on medical institutions and residents.

Case of Ajisai Net, Nagasaki, Japan
Ajisai (hydrangea) Net established in 2009 connects 282 hospitals and clinics including 30 major hospitals and 44 pharmacies in Nagasaki Prefecture, and more than 50,000 residents and patients are registered as of 2016. The original objectives were for clinics (primary care doctors) to access medical data of patients who were transferred to large hospitals by them and see their real time medical situations, besides sharing basic medical information of patients. The costs to clinics include initial fees which are JPY 83,000 (USD750) and monthly fees which amount to JPY4,000 (USD36). The medical data they share include (i) medical records, (ii) test reports such as ECG, x-ray, endoscopy, CT, MRI, and so on, (iii) operation history, (iv) medication, and (v) allergy. There are two major medical information systems in
Japan, namely “ID-Link” of NEC and “Human Bridge” of Fujitsu, but it is difficult to integrate these two systems since their fundamental structures are different. The hospitals in Ajisai Net own these different systems. Ajisai Net thus can view data from two different systems by dividing the PC screen into two. On the other hand, Ajisai Net cannot store the data, which limits the further expansion of the system. This is different from other cases of the US and UK, as seen in what follows. As mentioned previously, Ajisai Net was aimed to construct the network mainly for supporting primary care doctors to follow up patients transferred to major hospitals. The low charges to clinics are a source of its economic sustainability and only four clinics resigned their membership since doctors became too old to use the system during ten years operation. But Ajisai Net requires the substantial upgrading of functionalities such as saving and storing data to be big data.

Case of Healthix, New York, US

Healthix is an NPO and is referred to as Regional Health Information Organisation (RHIO). It was established in 2010 by integrating five RHIOs around New York City. The Healthix network connects about 500 medical institutions including hospitals, clinics, medical testing services, image analysis centres, nursing homes, and as a result, it shares the health records of 16 million residents. The data include (i) personal attributes such as age, gender, blood type, address, race, weight, height, education, (ii) history of treatment, (iii) medication, (iv) reports of tests and examinations, and (v) allergy. The characteristics of Healthix, which is referred to as Health Information Exchange, are summarised as follows: (i) the system shares real time data, (ii) promotes work flow in medical institutions, (iii) security, and (iv) accumulation of large number of data. The Healthix system can sort and collect the necessary data of a particular patient in his/her data stored at different institutions in the standardized format, which is referred to as “single version of relevant data.” It is the algorithm that enables it to collect such data automatically from databases of different medical institutions, that is, the medical information networks owned by each institution are connected and integrated by “the intelligent interpretation algorithm.” The basis of this is that medical records are formatted in the standard way, and the algorithm can collect the desired data. The algorithm does not require any patients’ ID, which secures privacy of patients. By using all data of a patient, medical doctors can provide the best treatment or clinical path in an efficient manner. The most advanced nature of Healthix lies in “Population Risk Management,” which is enabled by the accumulated data in the network. One example is found in the prediction of diseases. Healthix has been accumulating millions of data and by using this, patients can be categorised by the level of diseases. For example, the degree of diabetes of a patient can be forecast based on the experiences of patients with the same degree and the same physical conditions such as values of HbA1c, weight, blood pressure. The probability of their diabetes becoming worse in six months later can be predicted by comparison with others in the same category. This leads to triage of patient and efficient use of scarce medical resources. The combination of statistical tools using AI and big data has the potential of creating the next generation of medicine.

CMC, London, UK

The network of CMC (Coordinate My Care) in London, the UK, also shares medical information of residents among medical institutions and supports care at home. CMC is a NPO and was established in 2012 by the Royal Marsden Hospital which specialises in cancer. Currently CMC has 25,000 registered residents. CMC collects information on patients not only from regular institutions such as GPs, hospitals, hospices, home care and nursing homes, social services and community services but also from institutions providing urgent care such as NHS 111, ambulance services, out of hours GPs, urgent care centres, and A&Es. The characteristics of the CMC system is thus to focus on the relationship with urgent care. CMC’s services are referred to as the urgent care plan, and residents can register their desired plan. The patient’s medical information is recorded in the standardised format which includes (i) urgent care summary, (ii) patient consent, (iii) patient details such as allergy, (iv) significant medical background, (v) emergency care plan, (vi) medication, besides information on date of birth (age), NHS number, gender, and address. The original objectives of CMC were to take care of cancer patients at the terminal phase staying at home, but it is not limited to cancer patients. This is due to the fact that in London 80% of patients passed away at the places other than hospitals, which requires urgent care to support those patients and families. The CMC information system is the same as Healthix. The results of CMC care survivors...
show that CMC patients have fewer hospitalisations, and reduced hospital stay, urgent call for ambulance, and visiting out of hour GP than non-registered residents.

**Comparative analysis of three networks**
Based on the previous examinations of three regional information networks, their common success factors are presented. First, information on patients is clearly targeted. It seems that there is an implication that the more information the network owns the better system, but this is not true, because more information provides a heavier load to the system, which leads to greater costs, and this impairs the sustainability of the system. As mentioned, Ajisai Net does not store the data, which makes the network simple and reduces the charges to clinics. On the other hand, Healthix does not handle image data for the same reason as Ajisai Net. The second factor is that the networks are used for promotion of work flow in the care provision. In addition to prevention of double examinations or double medications which was the main target in the early network of the 1990s, medical institutions make use of the network to enhance efficiency by reducing manpower and costs. IT in general is introduced mainly to enhance efficiency. In the US, since medical care is provided in the framework of the market mechanism, the incentives to reduce costs are enforced by all kind of medical institutions. The third factor is economic foundation of the networks. Three networks are operated by NPOs and receive some kinds of public funds; in particular Healthix receives financial support from local and state governments, while Ajisai Net receives less. How to finance the regional medical network is an important issue and further analysis is required for economic sustainability of the network, since the introduction of the network is not final aim, but it must own the sound economic foundation.

The most important envisioning of the regional medical information network is how to utilise the data collected by networks. A conventional way is to promote efficiency of medical care. To date, the advancement of software using AI enables various new applications possible. The prevention of diseases or prevention from getting worse, as mentioned in Healthix, is a typical example. For this purpose, more data or information is required to be collected.

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