Citizen-Centric Approach and Healthcare Management Based on the XML Web Services

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Abstract: We propose recommendations on how to improve healthcare management by utilizing the XML Web services, which enhance the quality and promote the efficiency of healthcare and medical services with a citizen-centric, patient-oriented approach.

Keyword: Citizen-centric, Patient-oriented, XML Web Services, Healthcare Management, Hub & Spoke, Collaborative Health.

1. Introduction

As Japan is well on the way to an aging society, it is essential to reinforce citizens' health management and disease prevention as well as to reduce increasing public share of medical costs. In order to achieve them, it is necessary to improve the quality of the health services in cooperation with e-government and e-local governments as unifying force (hubs) to utilize a variety of functions such as authentication, security, procedures, and procurements.

As has been the pattern, individual medical institutions including clinics and hospitals had independently responded to the medical needs of citizens. However, the current condition with advancing medical technology, deficit operation of medical institutions', and lack of doctors makes it nearly impossible to respond a variety of medical and healthcare needs of people. This issue is especially serious in countryside areas hence optimization of management resources for healthcare and medical services is very much in need. As a strategic solution for this issue, we propose creation of a cooperation network among municipalities, hospitals and clinics, nutrition counseling centres, corporations, and university research centres.

The purpose of our study is to contribute to the construction of a citizen-centric, reassuring system especially for community medicine and healthcare by proposing a cooperation system for the medical information service based on the XML Web Services technology.

2. Increasing need for healthcare services

With the rapidly ageing population, Japan has the world's highest longevity rate today. As a result, a reform of the conventional healthcare at hospitals is required. That is, building a cooperative structure with related organizations, institutions, and citizens is strongly required to establish a total lifetime healthcare not only for sick people but also for healthy people to swiftly respond and figure out the medical, healthcare, and welfare needs of all the citizens (Hori & Ohashi 2004c).

Conventionally, medical care has functioned specifically to diagnose and treat illness. Nonetheless, today's scope of medical care is required to include health maintenance and promotion, prevention of disease and early detection, early diagnosis and treatment, and elderly care. Furthermore, people have become more conscious about not only *cure* but also *care* to live a healthy life.

As a nation, the Japanese government enforced the health promotion law in May 2003 to respond the increasing needs of a comprehensive approach to health promotion including nutrition improvement to cope with the rapidly ageing population and lifestyle-related diseases. The law intends to provide necessary health-related information and educate people about essential topics for modern lifestyle such as diet, exercise, drinking, smoking, and teeth. Moreover, it promotes the provision of the precise information regarding the nutrition labeling and safety of drugs and medicine (Ministry of Health, 2000-2001).

Regarding medical information, it has long been difficult for patients and citizens to access a variety of information including insurance, illness, and

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treatment that are essential to choose appropriate medical institutions and receive proper treatment. Especially in countryside areas far from urban cities, there are much less medical resources such as healthcare centres and medical institutions. Furthermore, even in urban areas, it is hard to access appropriate information regarding healthcare and medical services for single elderly people as well as female workers working at home or rearing child who are restricted in terms of time, and social and occupational opportunities.

According to the National Survey on Lifestyle Preferences released by Cabinet Office in Japan in 2002, Japanese people are highly concerned with health. They showed a strong interest in healthcare and medical treatment from the perspective of welfare and in the safety of food and medical products, which was included in the section of income and consumption. By looking at individual life stages, 40.9 percent of families with at least one of the children became independent said that the most important issue for their future life was healthcare and medical treatment, and it was 52.2 percent for families with all of whose children became independent. Furthermore, 29.0 percent of those couples 40 years of age or under without children or with children age under 6 years old said that the most important issue for their future life was income and consumption including the safety of food and medical products, and healthcare and medical treatment accounted for 21.9percent. The figures of those families with children who were in K-12 and college were 32.2 percent and 21.6 percent respectively.

The reasons of their high concern regarding these particular areas can be as follows: 1) recent food safety-related incidents of corporations and medical accidents at medical institutions, and 2) increasing health problems (mental and physical) including lifestyle-related illness and depression caused by growing stresses due to the rapid progress of urbanization in neighbourhood, family, and workplaces.

Today's ubiquitous society has made it easier for us to communicate with many people including those unknown online; however, as it very much differs from the traditional communication style and could lack the humane interactions, much has been discussed that it is affecting people's mental health. Moreover, telework, the new working format of 21st Century, which is drawing a high degree of expectation, also concerns loneliness and sense of isolation as its disadvantage, and these concerns are thought to raise critical issues for human resources and management (Hori, 2001, Hori, 2003, Hori & Ohashi, 2004b, Hori & Ohashi, 2005b).

Government, municipalities, corporations, public healthcare centres and medical institutions, universities and research institutes have made exertions for healthcare and illness including maintenance, prevention, treatment, and rehabilitation. However, there are many issues regarding their ability to appropriately respond to today's rapid changes in disease structure and progress in ageing. Additionally, not only in under populated areas but also in countryside prefectures and small cities we are faced with serious issues including shortage of medical practitioners, and municipalities budget deficits, and deteriorating management at public medical institutions to name a few. In terms of medical care, it is too difficult for medical institutions and hospitals themselves to meet the diverse needs of a great variety of patients. In terms of management, it is imperative to cope with the issue of selection and concentration of healthcare areas as it would make it impossible for local hospitals to meet the needs of local residents' if they focused only on selected areas of healthcare for the sake of rationalization and management strategy, Hori & Ohashi, 2005a.

It is critical to cope with those issues from the perspectives of total optimization for each region. In other words, it is essential to take a citizen-centric, patient-oriented approach to determine the appropriateness of functions and locations of medical institutions from the viewpoint of residents (Ohashi, ed, 2005). In addition, it is highly important to create a cooperative network among not only medical institutions including hospitals and clinics but also among municipalities, corporations dealing with food, medicine/medical devices/care centre facilities, nutrition centres, and universities and research institutes to improve patients and residents' quality of life including health promotion, prevention of diseases, medical treatment, and rehabilitation (Hori & Ohashi, 2004c). We introduce and review some useful health care systems including the "Collaborative Health" by Microsoft, which utilizes the medical information services and develops solutions to meet the needs of patients and medical institutions in the next chapter.

Based on these notions, our study aims to enable patients and residents to access a variety of essential information for maintaining good health and preventing diseases, and enable them to make an educated decision regarding the treatment they may receive in case of illness. Furthermore, we would like to propose the utilization of medical information services based on the XML Web Services which would encourage municipalities, hospitals, clinics, and healthcare-related corporations to provide and share appropriate information through the network (Ohashi

edi.,2003a)(Ohashi edi.2003b). As an organization of this paper, we first discuss the current challenges that medical institutions are facing and propose the integrated solutions to solve these problems. Second, we discuss the indispensable value of the XML Web Services and propose the building of the comprehensive collaboration foundation utilizing the XML Web Services across healthcare organizations, and describe the system we have developed.

3. The challenges of conventional healthcare systems – The hub & spoke type healthcare collaboration system model

Many existing technologies and software being applied to conventional healthcare computer systems have brought about a new set of challenges.

The first challenge is information fatigue and overload created by technology abundance. Widely popular communication tools such as instant messaging, email, fax, and voice mail have turned many employees into “information sorters” wading through information from many input s to find relevant information. The second challenge is inefficient collaboration, as we have not yet achieved the true collaboration with available technologies. We need to better utilize technologies to enable more efficient collaboration across workgroups that are being physically unbounded.

The third challenge is disconnected islands of data. Islands of disconnected enterprise data sets require too many different and complex user interfaces. This obviously has a dramatic impact on end-user training and productivity as well as on decision-making ability. The fourth challenge is connecting business processes. Often business processes are not well integrated with the way employees work and the productivity tools they use to get their jobs done. Finally, the fifth challenge is underutilization of productivity tools. Although significant investments in technology have been made, ways to drive revenue and reduce costs by getting the most out of those tools are still sought after (Crounse, 2004).

3.1 Issues of healthcare businesses

There are four major issues of the healthcare business that are interdependent: 1) healthcare provider’s issues, 2) health payers’ issues, 3) pharmaceuticals issues, and 4) employers and government issues.

Firstly, in terms of healthcare providers, it is said that physicians spend an average of 7 minutes with a patient in their office, and quality information at the point of care to support clinical decision-making is essential. There are more than 10 million healthcare workers in the US, and healthcare without boundaries equals to the empowerment of knowledge workers.

Secondly, regarding the issues of health payers, it is critical to efficiently and safely manage eligibility, authentication, claims and payments in order to conduct transactions. The fact that 20 percent of the people insured consume 80 percent of the healthcare spending is their major concern. The amount of spending largely depends on information being generated at the point of care. Hence, this issue significantly overlaps with provider’s business issues.

Thirdly, in terms of pharmaceuticals, their focus is how to shorten the time required developing new breakthrough drugs and medical devices, which involves intensive processes to complete clinical trials. This also equals to the empowerment of knowledge workers. Fourthly, in terms of employers and government, they are highly concerned with cost, quality, and access. Except for approximately $100 billion that patients pay by themselves, the government and employers in the form of health benefits pay the rest of the $2.4 trillion worldwide healthcare spending.

3.2 The hub & spoke type healthcare systems for collaboration

In order to collaborate productively and better serve people under care, it is crucial to empower knowledge workers and teams by providing them with necessary information. For this reason, we are aiming to add the following six key areas in the near future to deliver the full promise of collaborative healthcare (Figure 1): integration and application platform, mobility and devices, portals and collaboration, clinical and administrative forms automation, business & patient intelligence, and real-time communication (Microsoft, 2004b).

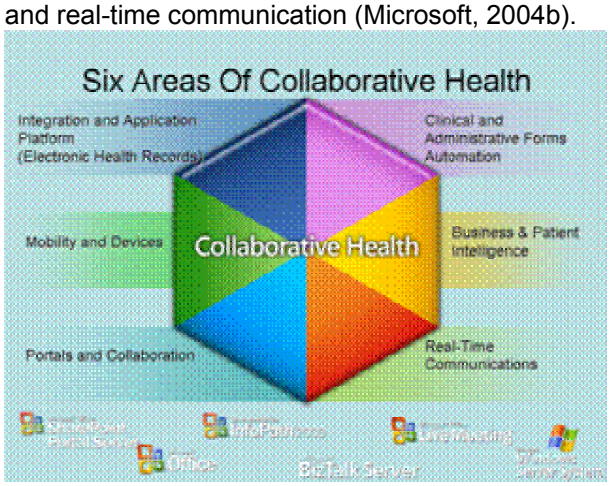

Figure 1: Six areas of collaborative health

3.3 Advantage of the hub & spoke type healthcare systems: infrastructure integration solutions for healthcare providers

There are many disconnected systems running among both hospital and health organizations. They in fact have a critical need to link many kinds of applications running on different platforms. To complicate this matter, almost all healthcare organizations always struggle to connect their systems with the automated claims processing systems of the insurance industry to maintain compliance according to U.S. HIPAA guidelines (Microsoft, 2003)

These complications can be eased with the utilization of hub & spoke type healthcare systems such as the Microsoft Collaborative Health. The hub & spoke type healthcare systems realize an easier way to manage integration, more cost-effective methods to access information, and faster methods to develop and implement new interfaces among systems.

These types of systems also provide organizations with a rapid, cost-effective way to take advantage of Health Level 7(HL7) standard. Commonly used among over 95 percent of U.S. hospitals, HL7 is now acknowledged as the global standard for electronic messaging in healthcare industry. The hub & spoke type healthcare systems enable many healthcare providers to access HL7 messages both quickly and efficiently, and they provide a powerful means for reducing complexity and integrating disparate healthcare systems.

Japan will start e-Report System 2006 at large-scale hospitals. We will approach the U.S-way of Healthcare System based on XML Web Services.

4. Providing real value to healthcare providers – next generation integration solutions

Today, healthcare industry moves faster than ever. Many healthcare providers face very challenging situation: in that how they can provide the best clinical care in a complicated and costly environment.

Although ICT is one of the key players to keep a valuable role to solve these issues, many of existing ICT systems may not overcome the challenge for most healthcare organizations.

Year after year, the cost increases and cutbacks, combined with mergers and ongoing staff shortages, have created unique pressures for healthcare providers and tangled their technology. In such situation, if there were the need to integrate many of existing and a brand-new ICT application on systems throughout organizations continues to grow, healthcare providers can no longer pay for extensive integration projects and long-term returns. This current environment has changed both the rational and the techniques that healthcare providers use in defining, purchasing, and implementing integration solutions.

For providing real value to healthcare providers, integration and messaging ICT solutions must deliver the following: 1) Simplified infrastructure and reduced cost, 2) Greater flexibility to handle demands and changes in the healthcare field, 3) Brand-new and innovative components that are easy to use and implement, and 4) An inherent ability to drive down costs, even as they support high-quality care with the right information in the right place at all times.

It is important to change the economics of hospital messaging and integration, making it possible for healthcare providers to take advantage of application integration technology in solving business challenges. Furthermore, it is also critical to reduce the complexity of healthcare integration, and deliver rapid return on investment through accelerated deployment times and simplified architectures. Additionally, it is crucial to provide a flexible integration platform that enables many healthcare providers to easily integrate their existing and brand-new ICT investments, develop robust business processes, and analyze these processes. And, it is also required to simplify the integration process by providing pre-built and comprehensive support for HL7 messaging. Finally, it is vital to deliver a robust messaging solution that enables healthcare providers to communicate patient information appropriately within and between healthcare organizations, allowing them to focus on patient care

5. Comprehensive foundation across healthcare organizations – utilizing the XML Web services

Comprehensive pre-built HL7 schemas and messaging capabilities combined with industry-leading tools and skill sets for ease of customization can decrease healthcare providers' time to value. In general, Healthcare organizations typically experience reduced acquisition cost for ICT solution and implementation, lower training costs, and fewer ongoing costs with implementations in weeks, instead of months, all yielding more immediate customer value. It is necessary to build a flexible foundation for providers to develop their ICT infrastructure beyond HL7.And it is ideal if

there were integrating applications within and across hospitals and clinics.

Aside from that healthcare providers concern about integration and messaging as a way to simplify their infrastructure and to reduce cost, they also seek greater flexibility to handle the demanding and changing healthcare field. They also concern about new and innovative components that are easy to use and implement. By reducing implementation and maintenance costs, provider organizations can get the right information at the right place so that they can deliver high-quality and timely care.

Therefore, it is critical to create the foundation for integration that connects healthcare providers to information providers and to their systems. By using real-time application integration and efficient messaging across the organization, healthcare organizations can support real-time collaboration, manage knowledge more effectively, and deliver personalized information.

Accordingly, development of user interface and framework that developers, business analysts, and administrators can all use to efficiently develop and apply rules and policies is vital for collaboration. For instance, developers can create vocabularies and bind business logic to data; business analysts can change policies practically in real time; and administrators can deploy and manage policies, and monitor the results. Then, the framework needs to be extremely flexible and extensible, so that its functionality has to be fully exposed through public interfaces to allow users to reach higher stage in implementation to meet their business requirements.

And, it is also important to construct massively scalable messaging and orchestration-based applications through scale-out architecture as well as to provide direct visibility into transactions to assure the correct and timely access to information for busyness analysts.

5.1 The XML Web services

Many organizations depend on large amount of information to effectively run their businesses, from tracking customer orders to gauging customer satisfaction. To collect such information is critical, but in many cases gathering necessary information results in inefficient business processes. We can see such practices vary from completely manual, paper-based systems to semi-automated steps involving standalone desktop applications, e-mail or redundant data entry practices dependent on human follow-through. In these cases, to cope with this issue, the XML Web Services can be implemented to improve and centralize the process of gathering information by using rich, dynamic electronic forms.

5.2 Problems with previous healthcare systems

Most healthcare organizations have almost hundreds of applications running in the enterprise. There is much information in silos across organization because these applications often do not “talk to” each other. Then clinicians find it extremely frustrating when they search information they required. In addition, every application has an extremely different user interface and workflow. This may be especially troublesome for clinicians who travel from one hospital to another. Every hospital may have a different clinical information system that the clinician is expected to use. Therefore, it is very tiresome and too difficult for clinicians to learn how to use all these different systems with their unique user-interfaces and work flow interpretations.

Today, many key decision makers are often unable to make informed decisions because the information they need is trapped within documents or databases in another part of the organization. So technologies such as the Extensible Markup Language (XML) and Web services have been helpful in improving business processes from server to server, but till now, they have not been connected directly to information workers at their desktops. This has meant that information workers have not had a way to interact with XML Web Services directly to access and use the enterprise information that they need.

5.3 Implementing the XML Web services

Therefore, it is essential to develop a user-friendly application that enables information workers at their desktops to use XML Web Services to access and use enterprise information in order to explore the full potential of the XML Web Services that streamlines the process of gathering information and makes it easier to reuse information throughout the organization.

Below is the image of a portal server (Figure 2). Each block of information is XML Web Service coming out of what may be entirely different applications; yet they are all synchronized and each block will change as the user drills down through the information he or she needs that is specific to a particular patient or problem. Clinicians can enter XML data that are stored on a server or relayed to a legacy clinical information system, and any column on the form can automatically be added.

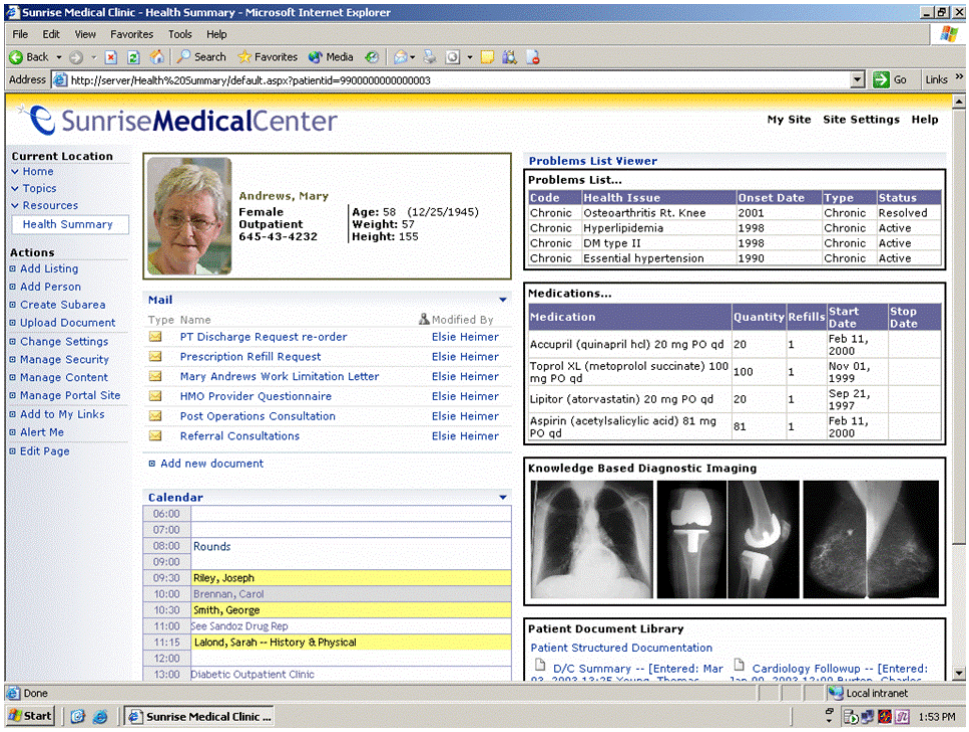

Figure 2: The image of a portal server

In case of developing a user-friendly application, there are a few points to be kept in mind. First of all, the application has to allow high flexibility for users to customize existing forms or build a custom form from scratch or from an existing data source. Secondly, it should provide a familiar environment in which users can fill out forms while the XML is automatically created behind the scenes. It should enable users to work with structured documents so that they need not to know anything about XML. This also reduces the amount of training required for them to become productive with the tool. Thirdly, the application should be compatible with widely used operation systems so that important information can be shared among collaborators.

5.4 Example of the XML Web services utilization

In order to meet the above-mentioned criteria, we have developed a prototype system and implemented the Web Services, XML messages, and MLLP (Minimal Lower Layer Protocol) ports for all communication between components in its lab order management by using InfoPath, NET Framework, and BizTalk Server 2004 as HUB Server (Figure 3).

The Web Services and the Patient List Web Part enable the physician to view lab order data in an InfoPath form by sending data in XML messages. The information shared between forms and databases is processed in BizTalk orchestrations. The BizTalk orchestrations act as the reference implementation's central engine for processing forms and routing lab orders and results to and from a lab information system. BizTalk Accelerator for HL7 (Healthcare Level 7) uses MLLP ports to communicate with a lab information system. A lab information system can be any application or lab information system used by a hospital to manage lab tests. For demonstration purposes, the reference implementation includes a lab simulator in place of a hospital's actual lab information system (Microsoft, 2004a).

The figure below shows an overview of how data is communicated between components, enabling BizTalk as HUB Server to process the business logic of lab order management. (http://www/microsoft.com/japan/smallbiz/healthcare/defaul.mspx)

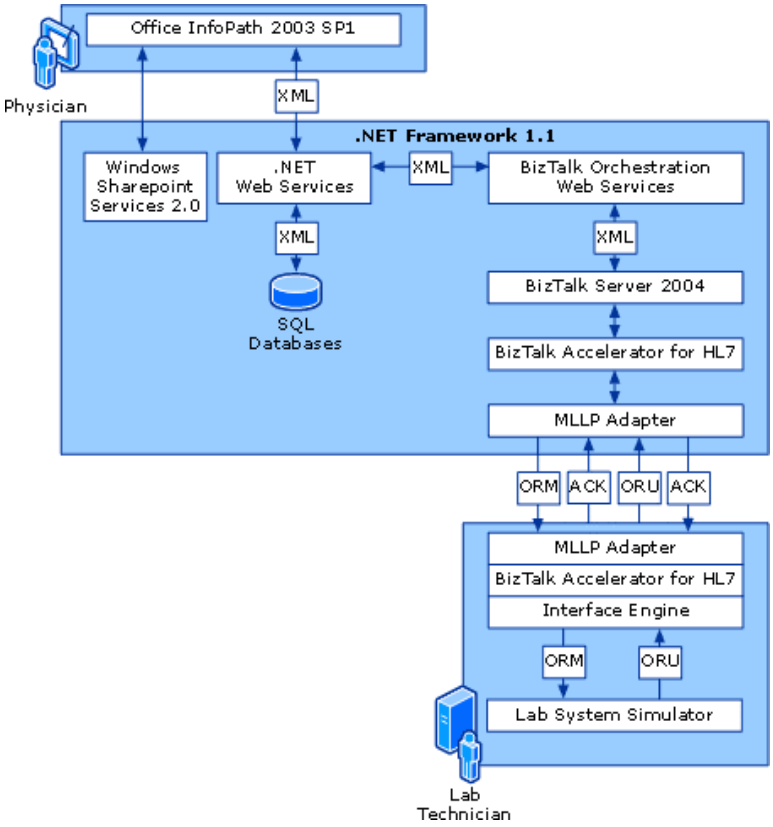

Figure 3: Web services and patient list web part

6. Conclusion

There are three main frameworks to be considered for the future of healthcare: 1) providing patients with medical information and supporting their decisions, 2) building a structure to provide a more efficient, high quality healthcare service, and 3) creating an assuring and comforting medical environment for citizens.

Future of healthcare services:

1) Providing patients with medical information and supporting their decisions
   (a) Respecting for patients' decisions and fostering self-responsibility
   (b) Building an infrastructure for providing medical information
2) Building a structure to provide a more efficient, high quality healthcare service
   (a) Providing a more efficient, high quality healthcare
   (b) Improving the quality of medical care
3) Creating an assuring and comforting medical environment for citizens
   (a) Maintaining and ensuring community healthcare services and promoting digitalization of healthcare services

In order for patients to make their own educated decision regarding medical institutions and kinds of treatment to receive, a variety of medical information at many different levels are needed. For example, promoting digitalization at medical institutions such as utilizing electronic medical charts would further assist the establishment of healthcare systems including health maintenance and disease prevention, welfare and nursing systems, and networking with pharmaceutical systems. We will be able to create an integrated healthcare and medical welfare network by connecting and coordinating a variety of systems. Coordination with a healthcare system would also contribute to the building of life-long health maintenance infrastructure for individual citizens (Ohashi & Hori, 2005).

Currently, individuals' medical records are segmented and isolated. For example, babies' medical examination data is recorded in mother's maternity passbook. Medical examinations for adults are administered with a variety of policies including the National Health Insurance Law, the Industrial Safety and Health Law, and the Elderly Health Law, and the results of the examination are printed out on paper and delivered to the patient. Hence, those segmented and isolated records should be digitalized and coordinated for each individual citizen. Furthermore, sustainable, flexible data-centric systems are essential especially in case of the changes in external environment such as relocation. If medical institutions could access the past medical examination records, it would highly improve the quality of medical practice and treatment. What is more, if these records

are coordinated and combined with the insurance systems, they together would assist evaluating each patient's health status and may create health improvement programs (Ohashi, 2003a)

In order to build an information system and realize these concepts, it is highly significant to take a citizen-centric, patient-oriented approach. In other words, taking a citizen-centric approach also means taking data-centric approach so that the system does not depend on other systems or applications distributed on the network. Moreover, from the perspectives of users, if the digital information is shared among multiple organizations, the system needs to satisfy the three criteria including record authenticity, readability, and storage stability. The system should also be able to be accessed and used with widely used standard interfaces, therefore utilization of the XML Web Services technology which we discussed is essential for building this system. Likewise, the system is considered to be ideal for long-term storage regarding the management of data's life cycle.

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