

Approach to Services Using Personal Health Records (PHRs)

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Due to an aging society and the increase of the average life expectancy in recent years, a common hope for people is to enjoy their lives at an old age instead of being unhealthy. Nevertheless, the rate of lifestyle disease patients over the age of 40 is significantly high and the large expense of the health-care system contribution for the elderly is a significant portion of the total medical care expenses of the entire nation. To tackle this problem, preventive healthcare that uses personal health records (PHRs) has been studied carefully in the pursuit of a solution. However, PHR data is scattered in various places nowadays: diagnostic information is managed at medical institutions, medical examination information at medical examination institutions or insurers (corporate health insurance associations, etc.), exercise information at fitness clubs and certain personal information such as weight at home. For this reason, it is important to gather those kinds of PHR data and provide them as IT solutions so that the PHR data is available anytime, anywhere and on any terminal. Fujitsu has been working to develop such a healthcare platform system, which gathers and utilizes PHR data, as a cloud service. Currently it is at a feasibility study phase to validate the service's effectiveness, by means of running its prototype system with trial users who are Fujitsu employees. This paper outlines the trial project and describes Fujitsu's approach to deliver the PHR-based healthcare services platform.

1. Introduction

As society continues to age and the average life expectancy increases in recent years, everybody wishes to live healthily and for a long time. Meanwhile, the rate at which people consult their doctors about lifestyle-related diseases, such as diabetes and hypertensive diseases, rises significantly when they reach their 40s. This, together with contributions to the medical system for the elderly, takes up a large portion of the medical care expenses of the entire nation.¹⁾ Due to these circumstances, it is important for each and every person to be aware of the importance of health and actively engage in preventive medical care.

To actively practice preventive healthcare, appropriate guidance according to the health

conditions of individuals is necessary and continuous health management based on it is desirable. Personal health records (PHRs) are one source of information that can support the health management of individuals. That is, PHRs are intended to allow "individuals to gather, store and apply their own health information for the purpose of maintaining and improving their quality of life (QOL)."²⁾

Fujitsu intends to use cloud technology to provide positive support for gathering, storing and applying PHRs.

This paper presents Fujitsu's approach to providing support for the use of PHRs.

2. Expectations for and challenges in application of PHRs

To curb the ever-increasing medical care expenses, medical care insurers must conduct specific health checkups and give specific counseling guidance, starting in fiscal year 2008. This is to prevent lifestyle-related diseases. Many ways to evaluate people's health in terms of behavioral science are available, including looking at the values of various tests and the degrees of engagement in health promotion. However, PHRs have not yet been analyzed in combination with actual medical care expenses and medical fee receipts to determine specific measures. To allow "anyone to choose and enjoy better health and medical services" throughout the entire society in the future, a mechanism for offering PHRs of individuals, with their consent, to appropriate parties is required. In addition, a PHR provision system and services that are capable of realizing this mechanism are desired.

These services are expected to help reduce medical care expenses by enabling individuals to appropriately choose hospitals and drugs. In the long term, the services are expected to lead to improved quality of medical care by giving feedback on the accumulated PHRs to pharmaceutical companies and research institutions.

Furthermore, easy availability of PHRs, as information closely related to daily living, brings the possibility of various PHR-related services. One such example is the use of PHRs as a life-log for recording weight together with photos of meals taken with a mobile phone.

At present PHRs collected on a daily basis are scattered in various places: diagnostic information is kept at medical institutions, medical examination information at medical examination institutions or insurers (corporate health insurance associations, etc.), exercise information at fitness clubs and information such as weight at home. The management

of these PHRs is not feasible. Accordingly, it is necessary to make these different types of information available anytime, anywhere and on any terminal, and a cloud environment is a good candidate for the realization of PHR services.

Challenges such as linking PHRs with various types of equipment to widen the range of PHR applications and the provision of an environment and guidelines³⁾ to ensure secure management of personal information must be addressed. Another major issue is how to define a business model to distribute the services.

Before these challenges can be addressed, actual PHRs must be gathered and their possible applications studied. Fujitsu is actively pushing ahead with a project targeting its employees to verify the gathering, storage and application of PHRs.

3. Project on use of PHR data

Using PHR data in specific applications requires the verification of a system for continuous gathering and storage of PHRs including vital data (weight, blood pressure, amount of activity, etc.) of individuals and medical examination results. In addition, the manner that the accumulated information can be used to improve the health of individuals must be studied. Fujitsu's project on the use of PHR data is described as follows.

3.1 Purpose

- 1) Provision of a health information platform capable of linking with various types of healthcare equipment (sensors) and integration with health applications (**Figure 1**)
- 2) Verification of applications of PHRs through the project (evaluation and verification of the effect of counseling guidance)
- 3) Study of new services that make use of PHRs

Demonstration project courses (seven courses)		
Mobile phone	Number of steps only	Course A
		With counseling guidance
Dedicated gateway	Provided by company T (Number of steps, body composition, blood pressure)	Course B
		With counseling guidance
	Provided by company O (Number of steps, body composition, blood pressure)	Course C
		Without counseling guidance
	Provided by company A (Number of steps, body composition, blood pressure)	Course D
		Without counseling guidance
Fujitsu's application	Sin Tai So Koubou + weight/blood pressure	Course E
		With counseling guidance
	Sin Tai So Koubou	Course F
		Without counseling guidance
	Genki-kun	Course G
		With counseling guidance

Sin Tai So Koubou: activity amount data automatically gathered with i-appli (i-appli is application programs operated on the NTT DOCOMO's mobile phone.)

Genki-kun: meals, weight, girth of abdomen, number of steps, etc. input with mobile phone

Figure 1
Linkage with various types of healthcare equipment.

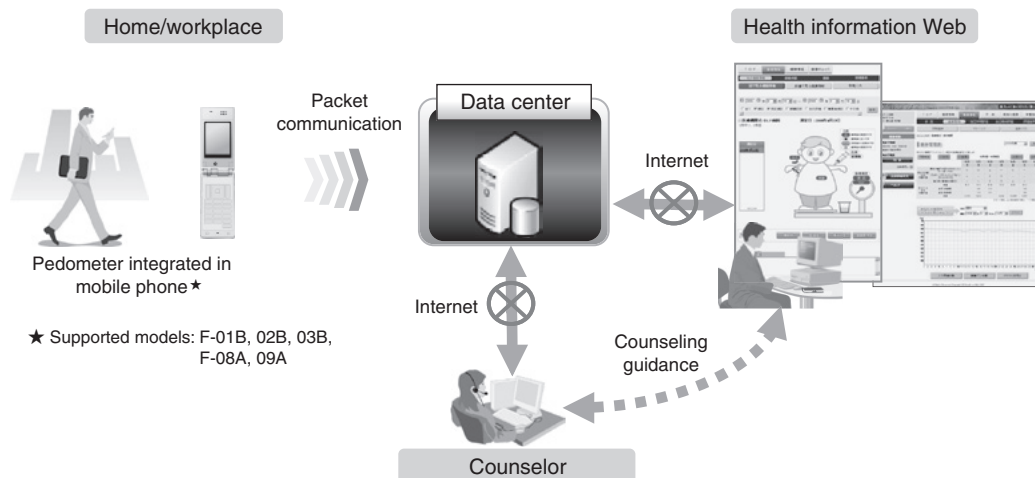


Figure 2
Storage of activity amount data and fitness support using mobile phone.

3.2 Project details

Healthcare equipment was distributed to about 2500 Fujitsu employees, having health insurance coverage, who applied for the project and their daily vital data were gathered. The measurement data were manually or automatically sent to a data center. Then support was provided based on the accumulated data to

enhance the health of the employees (between October 2010 and April 2011). To provide health support, data were gathered in two ways:

- 1) Measurement data were automatically sent to the data center by a pedometer (activity monitor) integrated in a mobile phone (Figure 2).
- 2) A gateway was connected to the Internet

at home so as to automatically gather the measurement data from a body composition monitor, blood pressure gauge and pedometer. This data was then sent to the data center (**Figure 3**).

Health support includes the following services to analyze changes in weight and blood pressure and changes in the amount of activity by the number of steps taken.

- A system was provided to allow employees to check day-to-day changes in their health status.
- Advice by health counselors according to the conditions of the individuals was made available (whether or not to use the advice was up to the employees).

Furthermore, medical examination data and medical fee receipt data owned by the health insurance association were integrated and specialists' opinions combined. In this way it is possible to comprehensively verify the relationships between the employees' health conditions and medical care expenses to use as feedback and help provide the health information platform.

4. Findings from PHRs

This section describes some trends found

from PHRs in the project.

4.1 Trends found from PHRs gathered

In addition to the demonstration of linking with various types of healthcare equipment, basic information for more effective counseling guidance is also gathered by the equipment. The gathered data are compared, and from these usage comparisons trends are found, as presented below.

- 1) Frequency of measurement for each course and healthcare equipment

The frequency of measurement has been compared with weight measurements, which is relatively frequently used, between Courses B, C and D, where data are transferred automatically as participants step on scales, and Course A where participants themselves manually input weight data. As shown in **Figure 4**, the frequency of use for automatic data transfer is four to five times higher than for manual data input.

The rates of data senders are about 40% for pedometers, about 40% for scales (body composition monitors) and about 30% for blood pressure gauges. If everybody is assumed to take measurements in an average way, the frequencies of measurement would be about once every two

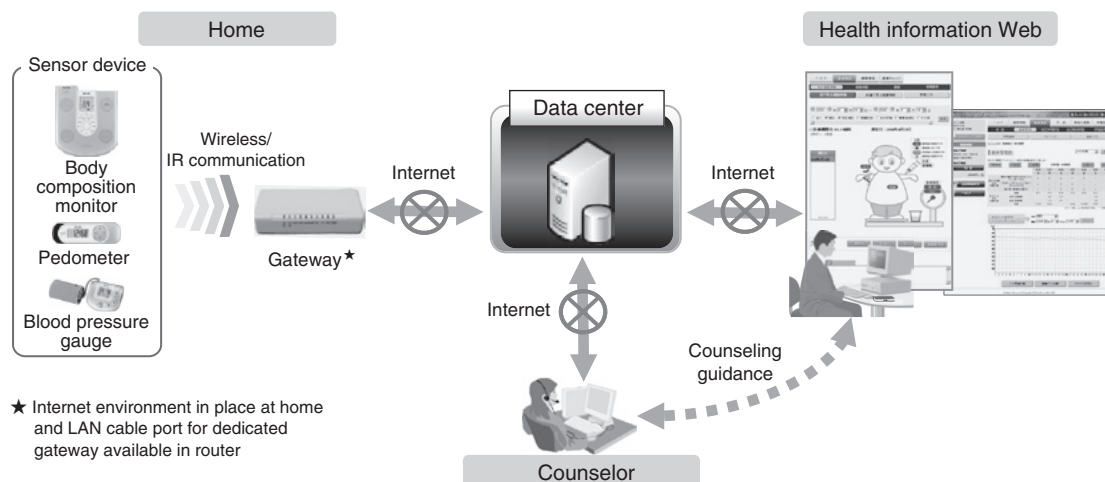


Figure 3
Storage and fitness support using gateway.

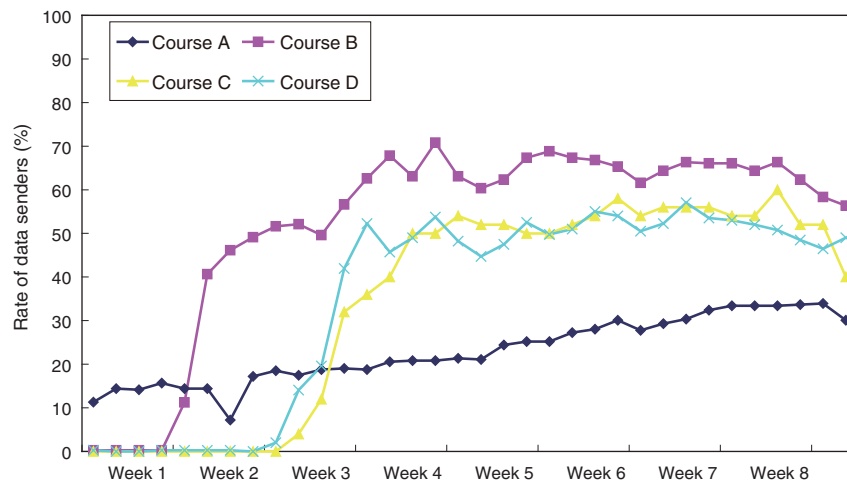


Figure 4
Rates of data senders by course.

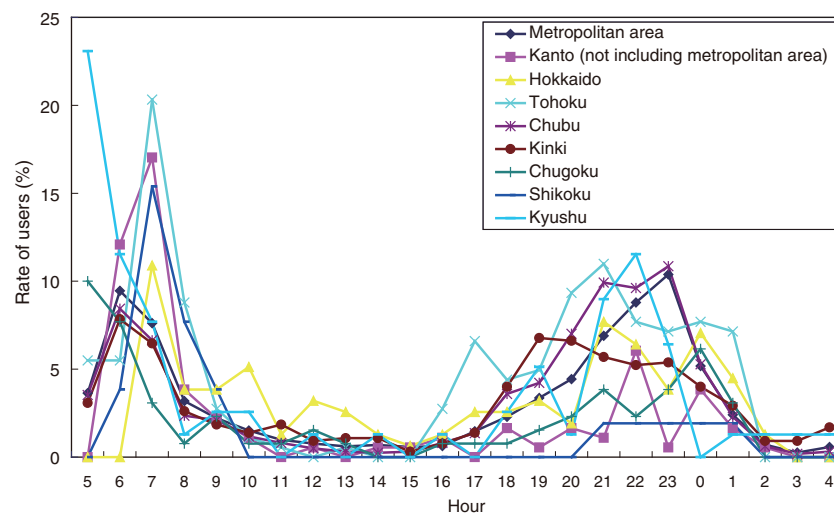


Figure 5
Measurement time of day by region.

days for the number of steps and weight and once every three days for blood pressure.

The rate of data senders for Course A, in which pedometer data are transferred by using mobile phones only, is about 30%. This leads to the assumption that using more healthcare equipment at the same time raises people's awareness and increases the rate at which they use the equipment as well.

2) Time of day of measurement for each region
Focusing on the time of day of measurement

(Figure 5), the following trends can be found (trends are similar for work days and non-work days).

- The peak of data transmission at night is at 11 p.m. in the metropolitan area and the Chubu region (the central region of Honshu, Japan's main island).
- The peak in Tohoku (the northeastern region of Honshu) and Kanto (the eastern region of Honshu) regions other than the metropolitan area is earlier at 9 p.m. and

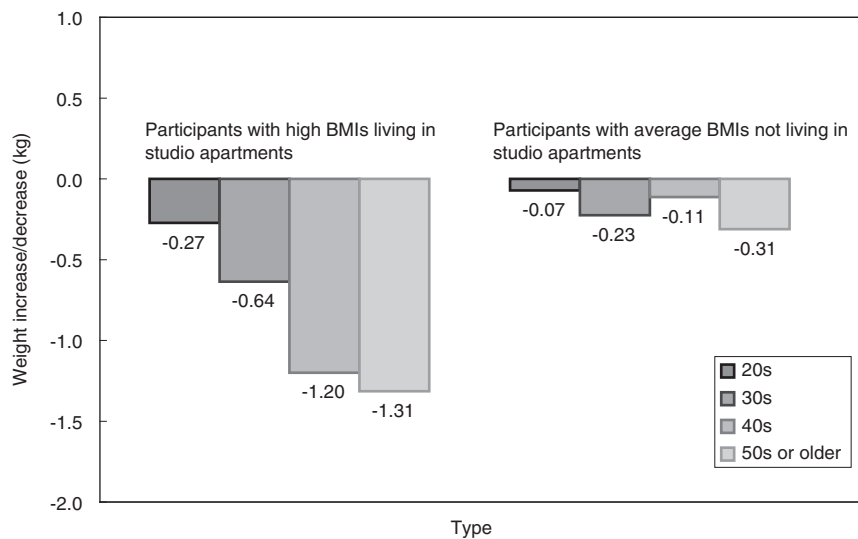


Figure 6
Weight increase or decrease by type of housing and BMI.

- 10 p.m. respectively.
- In Kinki (the southern-central region of Honshu) region, data transmission peaks are at 7 p.m. and slightly decrease until 11 p.m..
- The region with the latest peak at night is Chugoku (the westernmost region of Honshu) at midnight. In the Kanto region, excluding the metropolitan area, the rate of senders at the peak in the morning is significantly higher than at night (about three times higher).
- In Chugoku and Kyushu (the most southwesterly of Japan's four main islands) regions, the peak in the morning is at 5 a.m., earlier than in other regions.

These trends are mere examples. Combining with other factors such as occupational categories (including sales and development) and a person's sex may allow acquisition of basic data for considering counseling guidance that best suits the individuals based on the state of data gathering from equipment.

4.2 Combined analysis of PHRs

Acquisition of medical examination data

and the living environment from individuals in addition to day-to-day vital data gathered by healthcare equipment allows a finer-tuned counseling guidance.

Figure 6 indicates how living spaces and BMIs^{note)} relate to the rate of weight decrease. It is a comparison of weight changes in the first month between participants who have high BMIs and live in studio apartments and those who do not, as classified by age group. The figure shows that those with high BMIs, who are living in studio apartments and are relatively old, have a high possibility of losing weight by making use of the kind of counseling guidance in this project. In the future, combined analysis of various data is expected to help identify effective indicators, which can be taken into consideration in advance for conducting systematic and effective counseling guidance.

5. PHR application services addressed by Fujitsu

Continuing to lead unhealthy lifestyles may

note) Stands for Body Mass Index. BMI is a value indicating a degree of obesity based on an individual's weight and height.

cause an increase in severity or complications of ischemic heart diseases, apoplexy, and such like. Eventually, this could result in a need for nursing care. In this way, lifestyle-related diseases may lead to worse medical conditions and a rapid increase in medical care expenses as well. To avoid these situations, insurers need to analyze medical care expenses and implement healthcare programs that prevent lifestyle-related diseases from progressing. Fujitsu has been studying how to construct a business model for preventing the incidence of health issues and an increase in their severity by exploiting the potential of data. Fujitsu is working on an algorithm to prevent an increase in severity, in particular. It uses medical fee receipts to monitor those who are recommended to undergo medical examinations or patients of lifestyle-related diseases and alert them when they fail to undergo appropriate medical examinations.

Throughout the project, the use of PHRs has been discussed mainly from the perspective of preventing lifestyle-related diseases of employees but, in the future, the scope of their application will concern every aspect of human living.

As a platform equipped for their application, Fujitsu intends to implement and offer a health information platform on the Fujitsu cloud. **Figure 7** shows a concept of providing health information services centered on PHRs, which is an overview from two perspectives:

- 1) Support for individual efforts for health promotion
- 2) Provision of higher quality services at medical institutions

There is a need to support individual efforts for health promotion, in addition to basic applications including provision of information for fitness clubs. The possibility of data linking with familiar places in daily life such

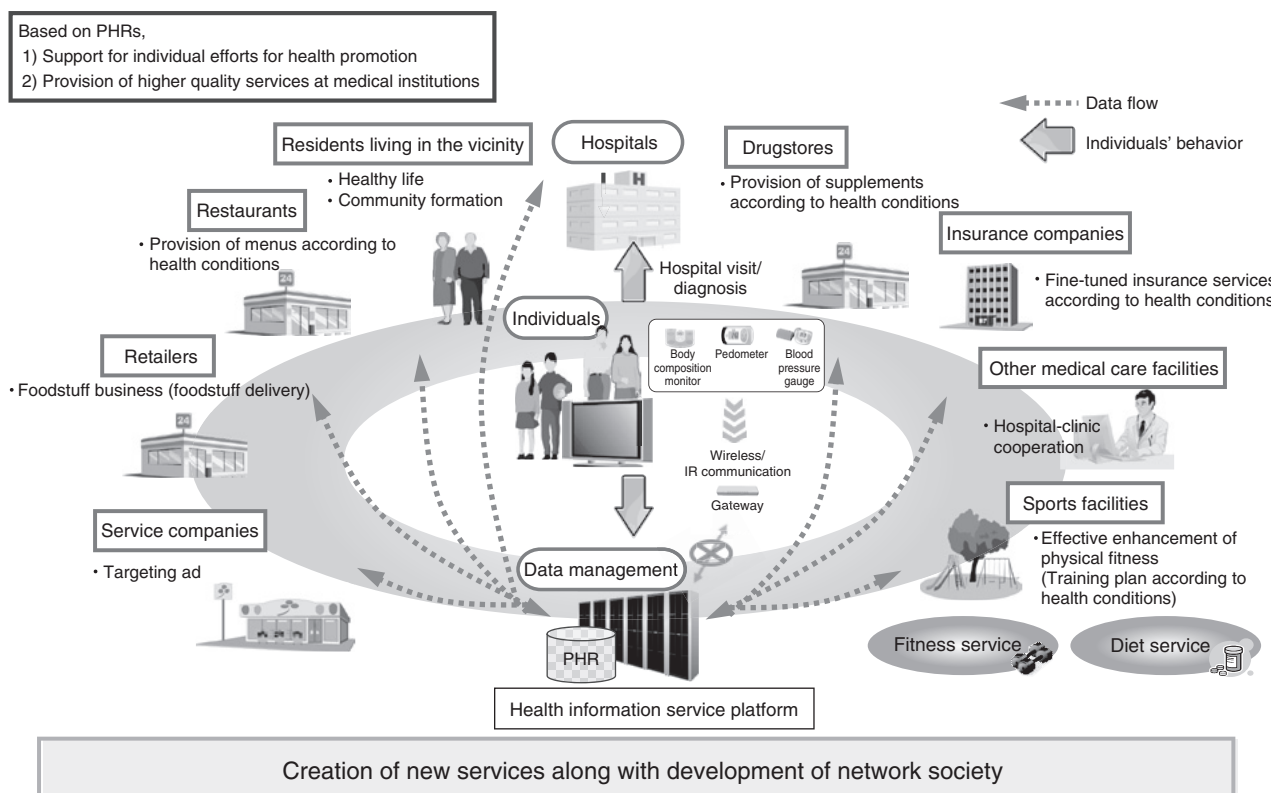


Figure 7
Health information service centered on PHRs.

as restaurants and drugstores will be actively sought.

From the perspective of providing higher quality services at medical institutions, smooth coordination of day-to-day counseling guidance at familiar regular clinics with specialist hospitals and everyday health management at medical institutions can be enhanced. In addition, a system can be built in which data accumulated through these services are made available to research institutions subject to agreement of the providers to make the whole of society a better place.

6. Conclusion

As mentioned at the beginning, a PHR service can be defined as the gathering, storing and providing individuals with their own health information for the purpose of maintaining and improving their quality of life (QOL). The owners of information are consumers as shown by this definition and they disclose the information at their own will and enjoy the services in the assumed system.

One familiar example in terms of individuals' health management is to make use of combined analysis of the accumulated PHRs with various opinions incorporated. This makes it possible to offer the services to enterprises that

support preventive healthcare of individuals.

In addition, the vision of a "Human-Centric Intelligent Society" including the smart city concept has been attracting attention recently. Linking between services across business categories, aiming to improve services by horizontally and vertically integrating various life infrastructures, has already started.

In these trends, "health and living," which precisely concerns people, is an important key phrase. Fujitsu is committed to providing various health information services through the Fujitsu cloud, aiming to build a society that is more human-friendly and easier to live in.

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