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## Health and welfare data on optical memory cards in Isehara city

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**Abstract.** An off-line network system of health and welfare for elderly people using optical memory cards has been established in Isehara city (Japan) since 1991. 2775 citizens have the cards and 24 offices have the terminals. It covers almost one third of people aged over 65 in Isehara city and almost all of the offices concerned with their health and welfare. About a half of holders use optical memory cards every time they visit these offices. The optical memory card holds data including basic data for health and welfare, health check data over 5 years, medical images with scripts and history of welfare services. All the data are useful for medical care, health consultation and management of health and welfare services. A card can hold health and welfare data for a lifetime, and it is easy to expand the system. It has been a good experience for us, because the optical memory card system needs co-operation among citizens, medical association and local government, and the experience will help us to expand the system in the future.

*Keywords:* Optical memory card; Health and welfare data, Medical image.

### 1. Introduction

Isehara city is located 60 kilometres south west of Tokyo, the capital of Japan. Isehara city has a population of about 95000, and has an area of 55.52 square kilometres. People over 65 account for 9% of the population of Isehara city.

#### 1.1. Object of 'Sukoyaka Card'

'Sukoyaka' means 'good physical condition' and this word has been used for a very long time, more than 1100 years.

In Japan, the Act of the Welfare for the Aged [1] was established in 1963 (changed in 1990), the Act of Health Service for the Aged [2] was established in 1982. Local governments, especially cities, towns, and villages concern themselves with health and welfare for the elderly.

Different specialists are in charge of medical care, health and welfare. Data about the health condition of an individual were stored separately and they could not be interchanged very easily. It aroused worries about the inefficiency of operation and the lack of appropriate support.

The combination of a central database in the city office and optical memory cards is one of the answers to these problems.

Table 1. Questionnaires to 'Sukoyaka Card' monitors.

sex	male 10,	female 30
age	male	62.7 ± 6.4
	female	56.6 ± 9.4
Do you think the system is useful?		
Yes 97.5%, No 0.0%, Unknown 2.5%		
Do you want to continue using the system?		
Yes soon 87.5%, Yes 10.0%, No 0.0%, Unknown 2.5%		

Table 2. Estimation of individual health data for lifetime.

Identifier and base data	1 KB
Health check data	46 KB
Report of consultations	65 KB
Report of visit to home	3 KB
History of vaccinations	7 KB
Welfare report	6 KB
Clinical data (texts)	800 KB
Clinical data (compressed images)	2000 KB

'Sukoyaka Database' for health and welfare is found in the city office, and optical memory card reader-writers are set up in almost all of the health and welfare facilities in Isehara city.

### 1.2 Short History of 'Sukoyaka Card' [3]

The basic study was started in 1986. In 1987, the prototype system was established. In that year a one-day health check and guide was introduced. This was called 'Sukoyaka Festival' and about 100 people participated. Each datum was stored in one optical memory card and finally displayed on a microcomputer for health check purposes.

In August 1990, 51 elderly people volunteered to be monitors of the Sukoyaka Card system. Health checks were performed every month and these data were gathered into an optical memory card. The main purpose was to obtain acceptance of an optical memory card system for health checks. The reports from the city office and the questionnaires to the card holders indicated wide acceptance (table 1).

In 1987, the Ministry of International Trade and Industry specified Isehara city as a 'New media community' to support a network system for people. In 1990, the Ministry of Health and Welfare strongly supported the health check activities and care for elderly people in Isehara. In this year, a wide spread study was started, and in the following year (1991) the fully operational use started, and now 2775 citizens have the cards.

### 1.3 Why 'Sukoyaka Card'?

As a result of this study, the quantity of data about health care and welfare was estimated (table 2). An optical memory card can hold a hundred years' data of an individual's health and welfare.

Each optical memory card has a capacity of 4 megabytes. It can hold about 200 medical image data using the JPEG compression method.

The data of health checks and welfare are collected in the database of the city office. Medical data are stored in hospitals and clinics, so the whole database about health and welfare for an individual only exists on an optical memory card.

As a result of widespread card reader-writers, an off-line network of health care and welfare for elderly people has been constructed.

An optical memory card does not allow users to change the data on it. An optical card system has an internal password and a cipher function [4]. In the system, a software security system is in operation. So, the system has enough confidentiality.

## 2. Material and method

### 2.1. Optical memory card

The Sukoyaka Card is manufactured by Canon Co., and it has the same size and thickness as a credit card (table 3).

On the surface of the card, the name, address, and telephone number of the card holder are printed. For emergency use, blood type and allergen are also printed.

The memory area of 4 megabytes is placed on the other side. A laser beam erodes small pits on this area to record data.

### 2.2. Data on an optical memory card (table 4)

A password to access data and a portrait of the card holder are recorded on the optical memory area for security control. The data of the card are classified into three major categories that will be discussed in the following sections.

**2.2.1. Health and welfare data.** The information gathered on an optical memory card are the basic data for services, the records of health care and welfare services, the health check data according to the law and the other records of health and welfare specially performed in Isehara city.

In Isehara city, the health check is performed in medical facilities. If the facility has a reader-writer of optical memory cards, the data are input each time on the card, and medical staff can make comparisons with the old data on a microcomputer.

If the facility is without a reader-writer, the data are recorded on an optical memory card in the office of the Medical Association of Isehara city. Health and welfare data kept by the city office are transferred to optical memory cards if necessary.

**2.2.2. Medical data.** The card holds two categories of medical data. One is the clinical records, mainly images. Electrocardiograms, X-ray photographs, conventional photographs including pathological images and images of endoscopy are recorded. Images are recorded together with documents (text data). The other is records of medical care at home, especially oxygen therapy. We have two major objects in recording these data. One is to gather the data of clinical activities in many hospitals, clinics and at home. The other is to accelerate good communication among staff who carry out medical treatment, health care and welfare services.

**2.2.3. Report data.** There is a free text field for medical staff, pharmacists, and welfare officers to report to each other. This field is mainly used to record the prescription history.

Table 3. Features of optical memory card.

1. <i>Media</i>	
Capacity	4.2 MB (no ECC), 3.4 MB (with ECC)
Size (mm)	85.6 × 54.9 × 0.76
2. <i>Reader-writer</i>	
Writing speed	3.76 KB s <sup>-1</sup>
Reading speed	7.52 KB s <sup>-1</sup>
Mean search time	0.5 s
Error rate	10 <sup>-12</sup>
Weight	7 kg
Size (mm)	225 (W) × 300 (D) × 116 (H)

Table 4. Data on the optical memory card.

1.	Identification
2.	Base data
3.	Emergency data
4.	General/basic health check
5.	Precise check
6.	Diagnostic test
7.	Third renal test
8.	Gastric cancer check
9.	Gastric cancer precise check
10.	Lung cancer check
11.	Lung cancer precise check
12.	Breast cancer check
13.	Breast cancer precise check
14.	Colon cancer check
15.	Colon cancer precise check
16.	Uterus cancer check
17.	Uterus cancer precise check
18.	Certification of bedridden
19.	Certification of living alone
20.	Welfare service
	delivering foods
	short stay
	bathing
	wash and dry bedclothes
	haircut
	give and rent necessities
	home helper
	emergency call system
21.	Visiting guidance (first time)
22.	Visiting guidance (continue)

### 2.3. Access card

Many types of access cards categorized by the operators' occupation are prepared to preserve the security of the card system (table 5). The data are categorized into hundreds of types and preserved from illegal access by software.

### 2.4. Terminals

The constitution of the optical memory card reader-writer and the associated microcomputer system are described in table 6.

These terminal systems are present in 24 offices including hospitals, clinics, a pharmacy, welfare facilities and the city office (table 7). It covers almost all of the health and welfare care institutions for the elderly.

Table 5. Security categories by occupation.

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Card holder
Physician
Dentist
Health visitor
city office, public health center, other
Nurse
city office, other
Pharmacist
Case worker
city office, medical facility, welfare facility
Physical therapist
Operation therapist
Dietitian
Lifesaving therapist
Lifesaving staff
Clerk
medical fund
city office
medical facilities
public health center

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Table 6. Feature of the terminal.

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1. Hardware	
CPU	NEC i486, RAM 15 MB, HD 500 MB
Printer	Graphic, Japanese
Display	
Optical card reader/writer	
2. Software	
OS	MS-Windows 3.1, CANON optical card driver
Language	Microsoft C 6.0

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Table 7. Location and number of terminals.

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City office	4
Medical facilities	17
Welfare facilities	2
Pharmacy	1
Public health centre	1

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The card holder can look at the data on the card at any of the institutions that have the terminal systems.

The five terminals in Isehara city and two clinics in the neighbouring cities (Atsugi and Ninomiya) can be connected by the Integrated Services for Digital Network (ISDN) ((Nippon Telephone and Telegram Co. (NTT) INS64). Flexible disks are used as a substitute for optical cards in the other cities [5].

## 2.5. Card holder

2.5.1 *Distribution of the card.* Those who want to be card holders are invited through public information or the Medical Association of Isehara city.

The city officer prints the portrait, blood type, allergen and password of the card holder on the card.

An optical memory card costs about 2000 yen. The city budget, and other support from the Japanese government, are used for payment of the whole system.

Table 8(a). Questionnaires to card holder.

Period	20–30 April 1993
Returns	488 (74.6%)
1.1.	Age 40–59 17, 60–69 180, 70–79 236, 80–89 7, 90–97, NA 2
1.2.	Sex Male 167, Female 318, NA 3
1.3.	Resident With family 359, Alone 112, Other 14, NA 3
1.4.	Need help Always 53, Sometime 44, No 371, NA 20
1.5.	Health status Good 121, Fair 83, Normal 190, Bad 78, Worse 12, NA 4
1.6.	Health check Per year 374, Sometime 60, Few 14, No 31, NA 9
1.7.	Consultation by physical condition in last year Yes 387, No 94, NA 7
1.8.	Hold 'Sukoyaka Card' anytime Yes 250, No 234, NA 4
1.9.	Remember password Yes 173, Ambiguous 81, Forgot 173, NA 61
1.10.	What kind of data in optical card I know 54, Ambiguous 137, Do not know 64, NA 26
1.11.	Do you want to know the data in your card? Yes 223, No 15, I do not care 189, NA 61
1.12.	Do you feel safe to hold optical card? Yes 169, Helpful 240, No 17, NA 62
1.13.	Popularization All people 133, Elderly people 79, No 113, NA 108
1.14.	Do you want to buy the card? Yes 314, No 90, NA 84
1.14.1.	How much (Japanese yen)? < 499 59, 500–999 166, 1000–1499 65, 1500–1999 18, NA 6

The fully operational use was started in 1991. Now, 2775 elderly people have optical memory cards. The number of elderly people who could have the card is about 9000.

**2.5.2. Display of the data.** Before accessing the data on the card, the card holder's portrait is displayed for security.

The data are displayed on the screen as report papers or tables. Card holders and their consultant can look at them and discuss them. Series of data, such as body size, blood test data and abilities of daily life can be displayed by the 'trend graph' or 'radar-chart'. This graphical presentation is useful to explain trends in health condition of the card holder.

Pictures, such as electrocardiogram and X-ray photographs, are also displayed with the report texts.

For laboratory data, the system can convert numerical data into a Standard Deviation Index (SDI) [6].

### 3. Results

#### 3.1. Questionnaires to card holder

In April 1993, questionnaires about the card system were sent to the first card holders. The result is shown in table 8.

Table 8(b). Questionnaires to terminal users.

Period	20–30 April 1993, 27 Jan–3 Feb 1994
Returns	16 (80%)
2.1.	Age 20–29 2, 30–39 5, 40–49 2, 50–59 2, 60–69 5
2.2.	Sex Male 10, Female 6
2.3.	Kind of facility Hospital/Clinic 13, Welfare Center 1, City Office 2
2.4.	Do you use the cards? Yes 14, NA 2
2.5.	Frequency > Once per week 5, > Once per month 6, rare 5
2.6.	Read the data Every time 3, Case by case 11, NA 2
2.7.	Data value Good 0, Fair 9, So so 5, No 2
2.8.	Holder's reaction Good 2, Fair 4, So so 9, NA 1
2.9.	Expansion of system Should be 2, Some day 8, No 5, NA 1
2.10.	Popularization Yes 12, No 2, NA 2

This system is mainly for elderly people over 65. It seems that women are concerned more about their health than men. About 20 per cent of holders need help in their daily lives. Nine per cent of holders do not check their health. Eighty per cent of holders visit clinical facilities in a year. Half of the holders always carry the card. Those who do not carry the card may think of the card as a kind of certification. Thirty five per cent of holders forget the password. It seems a very high rate. Forty six per cent of holders want to access the data by themselves. Most holders feel safe having the card. They say 'It saves me from repeated tests', 'We can easily recognize health data on the screen', 'We can avoid repeated questionnaires at various health care and welfare offices', and so on.

Over half of the holders hope the card system will spread. Over 60 per cent of the holders may buy the card. They think the card is worth about 1000 yen.

### 3.2. Questionnaires to terminal users

About 30 per cent of elderly people in Isehara city have the optical memory card. The frequency of use is not so high. But the terminal users think that the data are useful for their activities. The items that they think so useful are 'health check data', 'allergen side effects', 'medical images', 'welfare history'. They also think that the card is a useful tool for good communication with the customers.

Most terminal users want the system to expand.

## 4. Discussion

### 4.1. Aging of the Japanese community

Japan has experienced rapid and high level of aging of its communities [2]. In this paper, 'elderly people' is defined as persons over 65 years old.

In 2020, it is estimated that elderly people will account for 25 per cent of its population. The period to aging of the community is relatively short compared to the other developed countries.



It is suspected that conventional policies of health care and welfare bring low grade medical quality to individuals and high expenditure for social security.

The Act of the Welfare for the Aged established activities to support living at home and facilities [1]. It covers elderly people over 65 years old. The activities are led by cities, towns and villages.

The Act of Health Services for the Aged establishes medical care, health service and facilities. It covers citizens over 40 years old, but those who work in any industries are omitted.

The optical memory card holds the data according to both Acts. It also includes data of health and welfare, specially performed in Isehara city, and medical data.

#### 4.2. *Objects of 'Sukoyaka Card'*

When the system started, (1) protection of privacy, (2) usefulness for self health management, and (3) flexibility to expand the system, were expected.

4.2.1. *Secrecy of the data.* The optical card can contain the total data about a holder's health and welfare. The holder can control access to the data. There is a security system including the holder's picture and access control. We estimate the system reaches a practicable level for data security.

4.2.2. *Usefulness for self health management.* According to the questionnaires to the holders, the rate of receiving health check service is increased (76.6 %) compared to other elderly people without optical cards (38.1 %).

It shows that card holders take more care of their health condition than under the previous system.

Holders can look at a series of health data on the screen at the medical or welfare facilities. The display gives holders a feeling of safety and is well received by consultants.

Doctors belonging to medical facilities feel these series of health check data are useful for their activities. They think that continuation of health check data is important.

4.2.3. *Flexibility to expand the system.* Because an optical memory card can store a large amount of data, it is easy to expand the system. Data of oxygen therapy at home, medical image data, prescription history could be added after the system started.

A Mother and Child health database was built in the city office in 1995. These data will be recorded on the optical memory card in the future.

#### 4.3. *Initial evaluation indexes to the system*

At the start of the system, the following six indexes were set up by officers to evaluate the system.

4.3.1. *Easy access to self health and welfare data.* Terminals are in use at almost every medical, health and welfare facility for elderly people in Isehara city. So we can say the object is attained.

Card holders can look at the data when they visit those institutions. But they cannot see the data at any time. Terminals in public places with which card holders can look at the data by themselves are under consideration.

Table 9. Positive rate in a clinic.

164 card holders
newcomer
negative 23 %, need follow up 19 %, need medical care 13 %
on treatment
negative 34 %, need follow up 2 %, need additive medical care 5 %
others 4 %

4.3.2. *Increase use of health and welfare information.* Every optical memory card has the health data of many years. It is useful to see the transition of health data. Compared to other media, this advantage is well supported.

4.3.3. *Utilization of the characteristic of optical memory card for health and welfare.* Optical memory cards can have a large amount of data, and the system is devised to add flexibility. So extension can be done after the system start. This advantage is welcomed by offerers of the system.

4.3.4 *Increase communication among staff of medical care, health and welfare.* In Isehara city, there are three sections that manage procedures of health and welfare. Many people consulted more than two sections, and the data were stored separately.

The optical card system integrated the data and reduced redundancy. It introduced efficiency and good communication among the three sections.

From a clinical point of view, these data are useful for communication between staff in health and welfare facilities.

4.3.5 *Advantage for government activity of health and welfare.* In optical memory cards, there are qualification data for welfare. These data are used at welfare facilities in Isehara city. It has reduced the complexity of the previous office system and increased convenience for helpers.

4.3.6. *People's acceptance of secrecy of the optical memory card system.* Questionnaires to card holders show that half of them use the cards positively and recognize their effectiveness. The whole system, including the security system, seems to be socially acceptable. But the other half cannot recognize what kinds of data are stored in the card and how to use them.

Some clinical facilities say the security system seems to be too strict for accessing the data.

#### 4.4. *Future plans*

4.4.1. *Efficiency.* The data in optical memory cards are highly accepted by clinical staff and health consultants.

Most cards have only health check data of once a year. The number of card holders is only one third of elderly people. More cards and more data are desired. More data means expansion of the system.

4.2.2. *Costs.* In Japan, card system like 'Sukoyaka Card' are greatly supported (over 50 per cent) by the national government.

It takes about ten minutes to record clinical data on the cards and show the data to a patient at hospitals and clinics. We estimate that it costs about 2000 yen.

We propose, (1) initial cost for hardware and software should be paid for as public enterprise, (2) card holders should pay for the card media (according to questionnaires to holders, most holders think 1000 yen is an appropriate cost), and (3) insurance foundations should pay hospitals or clinics, with a card system, for consultation.

4.4.3. *Organization.* This system requires co-operation among clinical facilities including the Medical Association, welfare officers and a city office. The aims are different among these institutions. We propose coordinators to maintain the system.

Welfare facilities are often founded by prefectures or national governments. So the system must match the wide area network.

4.4.4. *Technical issue.* Standards for exchanging data, and small and light terminals, are required.

#### 4.5. *Estimation of clinical images*

Physicians in clinics have great interest in medical images taken in the University Hospital. Also they can send pictures taken in the clinics to the University Hospital to consult specialists.

For example, an uncompressed endoscopy photograph requires 768 kilobytes. Magneto-optical media are generally used to save and carry uncompressed images.

Optical memory cards require the non-reversible compression method. The JPEG compression method was tested and discussed by physicians.

We examined ultrasound images, X-ray photographs and endoscopy images [7]. Maximum tolerable compression rate is 1:10 for chest X-ray images and 1:50 for almost all other images.

#### 4.6. *Positive rate in a clinic*

Table 9 shows the positive rate of health examination in a clinic.

Forth-five per cent of health examinees were continually visiting a doctor. These people seemed to have a great interest in their self health condition and find it easy to use the clinics.

The physician of this clinic feels it valuable to gather data on an optical memory card.

## 5. Conclusion

The optical memory card system in Isehara city is widely accepted by citizens, local government, the Medical Association, hospitals, clinics and pharmacies.

Optical memory cards have the merits of portability, capacity for a large amount of data, and security. These characteristics seem to contribute to the success of the system.

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