

## Development of System for Reducing the Need for Nursing Care

*Setsuko Murata<sup>†</sup>, Toshiaki Tsuboi, Tatsuaki Ito, Kaori Fujimura, and Hitomi Sato*

### Abstract

NTT Cyber Solutions Laboratories has developed a care-prevention system to provide the elderly with scientifically proven instruction using broadband and video-communication technologies. This system can automatically assess an individual's risk of developing "old-age syndrome" characterized by falls and broken bones, poor nutrition, incontinence, and other conditions that generally require some degree of personal care, and it can generate optimal instructional menus based on that assessment.

### 1. Toward a prevention-oriented era

Japan's aging society continues to grow. Last year, the number of people 65 or older reached 24,880,000, the highest yet, or 19.5% of the population. These figures are expected to increase in the years to come: the 65-and-older population is expected to break the 35-million mark by 2035 and the ratio of elderly persons to total population is expected to reach 26% by 2015 and 35.7% by 2050 [1].

It has only been four years since the launch of Japan's Long-Term Care Insurance program, but paid-out benefits have already ballooned by 1.7 times to 5.5 trillion yen while services for those persons certified as requiring only a light level of living support have not been oriented toward improving their situation. Against this background, plans are being drafted to reform the Long-Term Care Insurance system with an emphasis on prevention and to implement those reforms in the 2006 fiscal year. It is thought that the number of elderly people that could benefit from care-prevention counseling is about 2.7 million nationwide and that about 100,000 counselors will be needed. Thus, there is an urgent need for a system that can provide efficient support for the work and administration of care prevention.

### 2. What is care prevention?

A care-prevention system aims to prevent a person from becoming bedridden due to "old-age syndrome", which frequently involves falls and broken bones, poor nutrition, incontinence, and home confinement. Realizing the importance of care prevention, some local governments are already taking action to implement measures such as group exercise classes for self-sufficient elderly persons and muscle-buildup training programs using expensive training machines. The training of care-prevention specialists has only just begun, and at present, care-prevention programs can be provided to only a small segment of the elderly population living in any one area.

In response to this problem, NTT Cyber Solutions Laboratories has developed a care-prevention system that exploits the features of video-related technologies including video streaming and multipoint video-conferencing. This system stems from the development of a home-participation type of care-prevention system in 2003 geared to self-sufficient elderly persons [2]. The usefulness of that system was demonstrated by a series of trials conducted in Bibai City, Hokkaido, in cooperation with NTT Communications Inc. [3], and the success of those trials led to the deployment of the system in the same city, where it is still being used. The newly developed system builds upon these achievements to provide total support for the work of care prevention. For example, it provides

<sup>†</sup> NTT Cyber Solutions Laboratories  
Musashino-shi, 180-8585 Japan  
E-mail: kaigoyobou@lab.ntt.co.jp

for the involvement of community centers, adds instruction menus for persons certified as needing only a light level of living support by the Long-Term Care Insurance system, and provides enhanced functions.

This care-prevention system aims to prevent falls and broken bones and prevent or alleviate inconti-

nence by improving the muscular strength of elderly person through exercise training (Fig. 1). It aims to prevent poor eating habits through nutritional counseling and to prevent or alleviate a homebound existence for elderly persons by providing them with more social contact through network-based consultation (net-consultation). The system provides instruc-

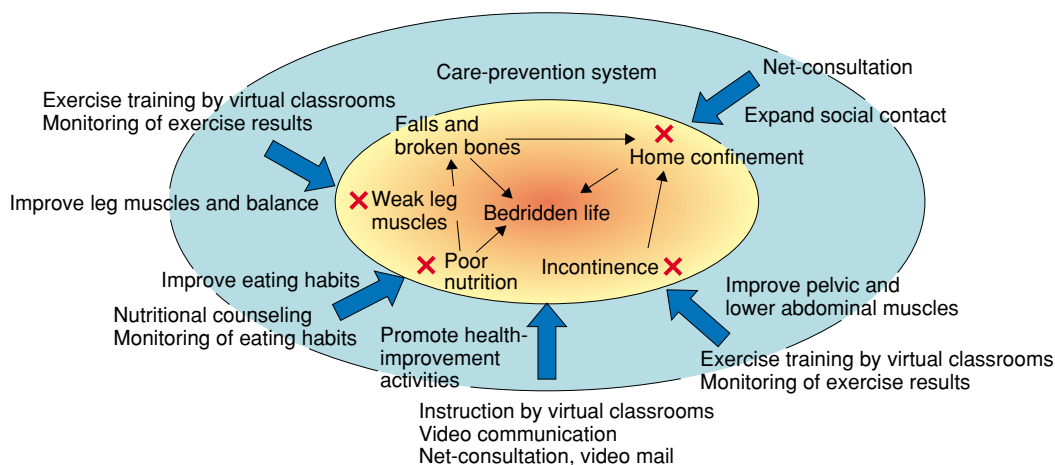


Fig. 1. Overview of care-prevention system.

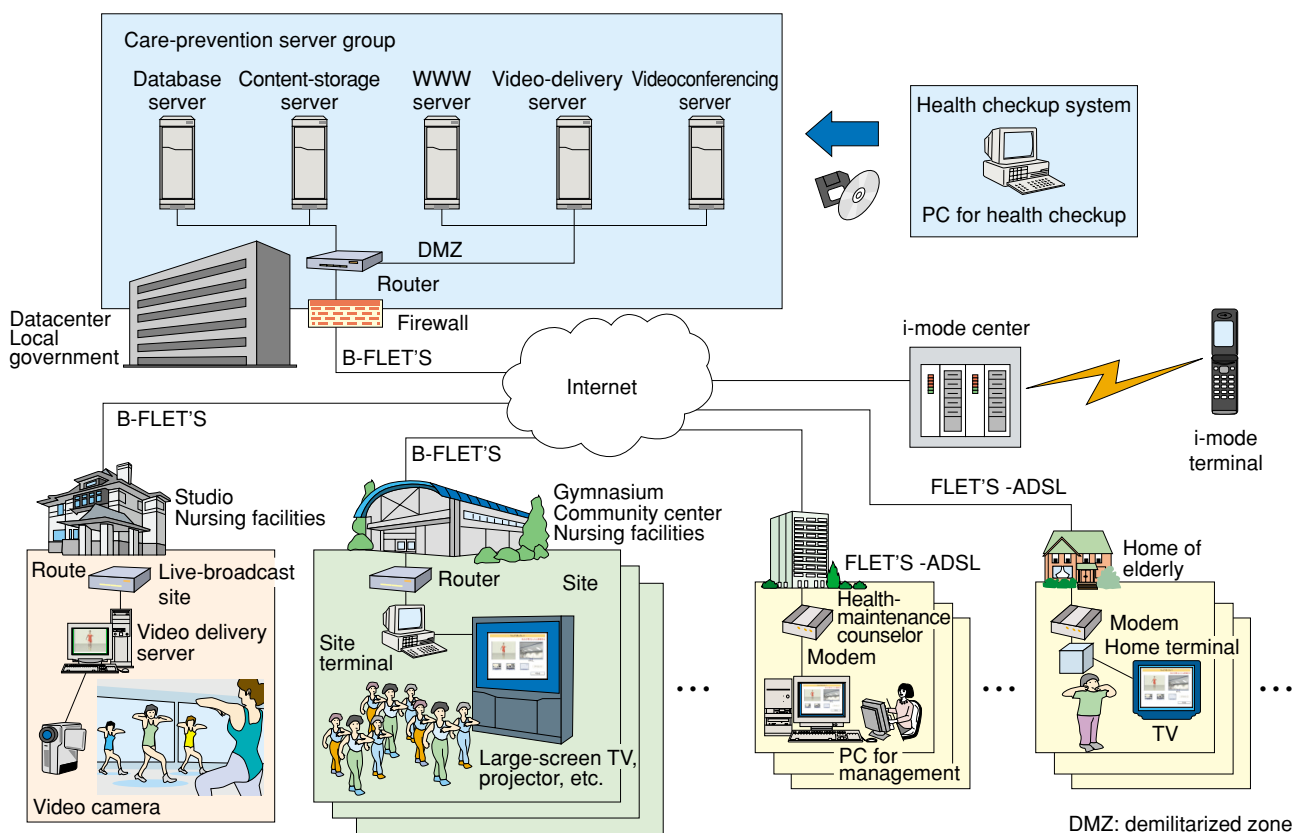


Fig. 2. Configuration of care-prevention system.

tion through virtual classrooms that gives elderly students a group feeling and provides and supports video communication with other elderly persons and care-prevention staff. These measures are designed to make the care-prevention program enjoyable and attractive to the elderly so that it can become a regular part of their everyday life. Although meal-planning and nutritional-counseling systems have already been developed using information technology (IT), there are no systems that provide total support for the prevention of old-age syndrome.

The basic configuration of the care-prevention system is shown in Fig. 2. This system makes it possible to conduct an exercise class that combines elderly participants at home with those at nursing facilities, community centers, health-maintenance centers, and other sites. It can connect with sites that produce live broadcasts of exercise classes given by trainers specializing in care-prevention exercise, enabling elderly participants to receive expert instruction in real time from their home or other sites. Care-prevention staff at remote locations can monitor exercise classes and review the exercise video of participants stored on servers so that they can then offer them encour-

agement or tips via net-consultation or video mail.

### 3. Health checkups

Based on gerontological studies conducted by the Tokyo Metropolitan Institute of Gerontology, we have developed a computerized health checkup procedure in the form of a 21-item questionnaire to assess the risk of a person developing old-age syndrome. The input screen for this health check is shown in Fig. 3 and a table of risk assessments for specific individuals based on the questionnaire results is shown in Fig. 4. This data can be passed to the care-prevention system to generate an optimal instructional scenario and a training schedule for elderly persons deemed to be at high risk for any or all of the conditions that require nursing care.

#### 3.1 Preventing falls and broken bones and incontinence

The care-prevention system includes an exercise-training menu to build up muscle strength. This menu is based on a program scientifically shown to be effective by studies supervised by the Tokyo Metro-

Otassha 21 Input screen

Input screen | Input list

Personal information | Q & A | Test result

1. Are you healthy? Relatively healthy
2. Do you take more than three kinds of medicine at present? Yes
3. Have you been in hospital in the past year? No
4. Have you fallen down in the past year? No
5. Have you been afraid of falling down recently? Yes
6. Can you go out alone in terms of the ability of your daily activities? Yes
7. Can you walk about one kilometer by yourself? Yes
8. Can you go up and down the stairs by yourself? Yes
9. Can you stand on your toes without any support? No
10. Do you have toilet accidents when you are late to go to the bathroom? No
11. Do you have toilet accidents more than once a week? No
12. Do you have any hobbies or take any lessons? Yes
13. Do you eat more than one portion of meat, eggs, fish, or milk every day? Yes
14. Do you cook more than four or five days per week? Yes
15. Have you quit a lot of things recently, which you had done before or had been interested in? No
16. Can you withdraw your savings and make a deposit in your account, pay charges for public services, and manage your family budget? Yes
17. Can you make a phone call, finding the telephone number by yourself? Yes
18. Can you take a fixed amount of medicine on a regular basis by yourself? Yes
19. Do you have a gripping strength of more than 29 kilograms for men or more than 19 kilograms for women? No
20. Can you stand on one leg with your eyes open for more than 20 seconds for men or more than 10 seconds for women? No
21. Can you walk 5 meters in less than 4.4 seconds for men or 5 seconds for women? Yes

Back Next

Fig. 3. Input screen of computerized health check.

Health check for care prevention "Otassha 21" matubara

No	Year	Individual number	Name (kanji)	Name (kana)	Date of birth	Age	Sex	Risk assessment for falls and broken bones	Risk for falls and broken bones	Risk assessment for incontinence	Risk for incontinence	Risk assessment for poor nutrition	Risk for poor nutrition	Risk assessment for physical weakness	Risk for physical weakness	Risk assessment for dementia	Risk for dementia
1	2005	00001300001	松原 菜々子	マツバラ ナナコ	1928/07/07	77	F	8	High	4	Normal	4	High	5	High	0	Normal
2	2005	00001300002	名古屋 翔太	ナゴヤ ショウタ	1920/02/01	85	M	4	Normal	2	Normal	3	Normal	4	Normal	2	Normal
3	2005	00001300003	西 拓哉	ニシ タクヤ	1922/06/30	83	M	15	High	9	High	13	High	14	High	4	High
4	2005	00001300004	静岡 ひとみ	シズオカ ヒトミ	1919/01/20	86	F	13	High	13	High	7	High	13	High	2	Normal
5	2005	00001300001	八幡 静香	ヤハタ シズカ	1925/08/08	79	F	4	Normal	6	High	0	Normal	2	Normal	0	Normal
6	2005	00001300006	東海 五郎	トウカイ ゴロウ	1930/04/11	75	M	9	High	4	Normal	7	High	8	High	0	Normal
7	2005	00001300007	後藤 あゆみ	ゴトウ アユミ	1920/09/26	84	F	11	High	7	High	14	High	14	High	2	Normal

Fig. 4. Risk assessment based on health questionnaire results.

politan Institute of Gerontology. It consists of five courses spanning 45 levels with more than 200 types of exercises. It includes exercises that can be performed while sitting on a chair for elderly persons who are certified as requiring only a light level of living support with the aim of reducing or at least maintaining the amount of nursing care they require. It also includes training for self-sufficient elderly persons such as *tai chi* that includes a “fun element” in the learning of new bodily movements. This exercise-training menu provides various means of making exercise an enjoyable and regular part of one’s life. An elderly person may choose to exercise with other participants in a group class held at a fixed time or alone at any time of the day.

The system provides a means of checking a person’s general physical condition and blood pressure before an exercise session to determine the suitability

of exercising on that day, and it issues a questionnaire afterwards to obtain comments on that day’s workout to determine the next exercise level for that person. And to improve user accessibility, the system uses a pen-tablet type of interface for the home terminal to make it as easy and convenient as possible for elderly persons to perform the above operations on their own.

Typical screen images of an exercise class are shown in Fig. 5. The double-screen mode shown in Fig. 5(a) enables the user to view the exercise instruction video for the scenario in question in combination with the video of his or her own site or even that of another site or the home of another participant. This feature aims to provide class participants with a strong feeling of group participation. The single-screen mode shown in Fig. 5(b) provides a zoom function for the exercise instruction video for those

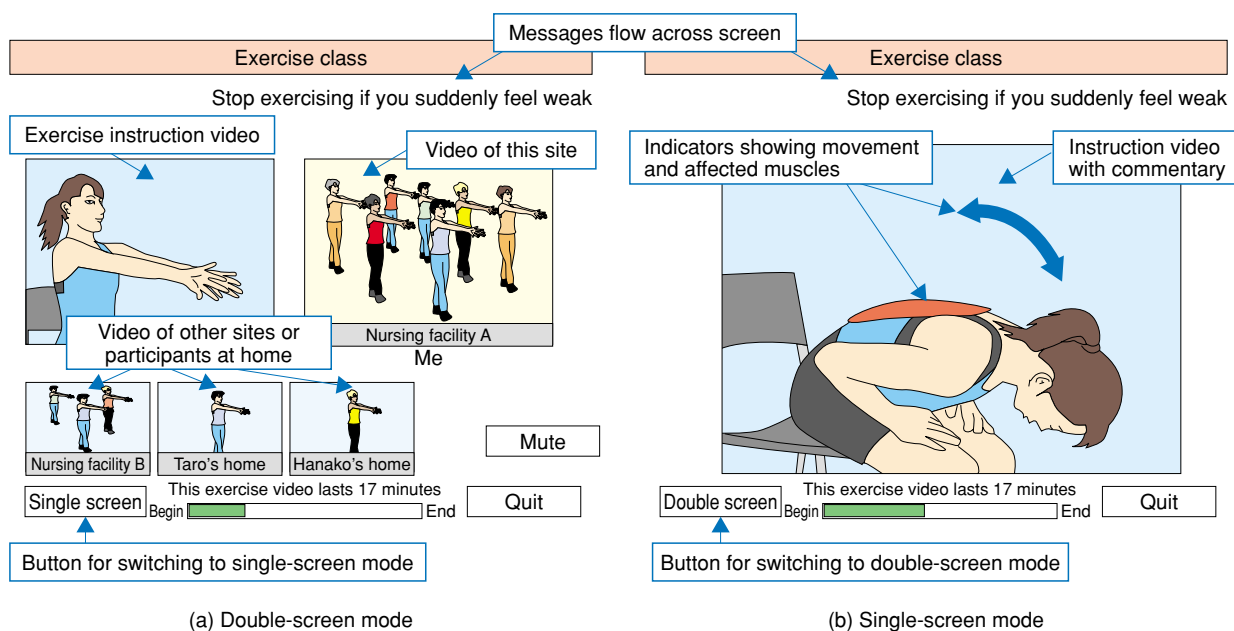


Fig. 5. Screen modes for exercise classes.

participants that would like to concentrate on the exercises themselves.

The system manages metadata related to exercise content. This enables optimal exercise scenarios to be delivered separately to each site or individual participating in the same exercise class according to the current physical condition of participants at a site or of an individual at home and whether detailed exercise explanations are needed. In particular, the system can check each participant for back pain, knee pain, and pain in the thighbone before the exercise session and can then select exercises that do not overburden the knee, for example, for individuals experiencing knee pain. It can also deliver content with commentary for individuals or sites that desire more detailed exercise scenarios.

### 3.2 Preventing poor nutrition and home confinement

As shown in **Fig. 6**, a user can select either “Yes” or “No” in response to whether they have recently eaten food from each of seven food groups (meat or fish, legumes, eggs, dairy products, vegetables, grains, and fruits). The results can be used to assess risk, and those individuals at risk of suffering from poor nutrition can be presented with meals and recipes that make up for the foods that their diet is lacking. This type of nutritional counseling was developed by the Tokyo Metropolitan Institute of Gerontology.

The user may also register a 30-s video of a pre-

pared meal taken with a camera so that a remotely located member of the care-prevention staff such as a nutritionist can offer advice by net-consultation or video mail. Creating opportunities for communication with care-prevention staff by net-consultation creates more social contact and helps prevent the user from feeling shut in.

### 3.3 Making health and exercise a regular part of life

To inspire elderly persons to continue with their care-prevention efforts, our care-prevention system provides instruction in the form of regularly scheduled virtual classrooms that help participants feel part of a group. It also enables participants to enjoy video communication with other participants in the same classroom before and after each class. The system aims to provide a support environment for making friends analogous to places in real life where people gather to chat such as a local park or employee lounge. Virtual-classroom participants may send questions to care-prevention staff by video mail and even exchange video mail with fellow participants. The care-prevention system provides a health diary for entering and storing vital signs data such as weight, blood pressure, and the number of steps walked as well as a video diary for recording and playing back health-related activities. This system aims to make health an integral part of an elderly person’s daily life.

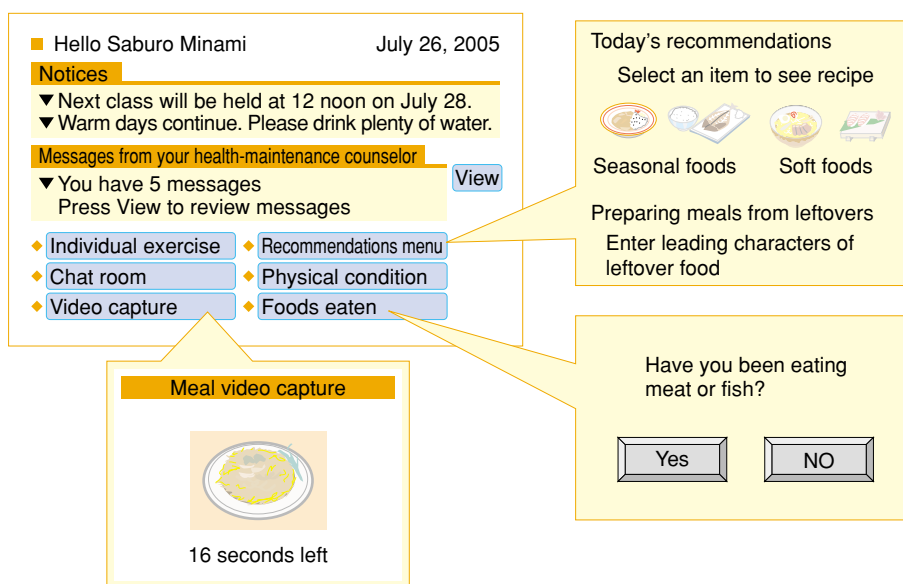


Fig. 6. Example of nutritional counseling.



#### 4. Future outlook

In Japan, the number of facilities or institutions targeted for care-prevention services comes to about 10,000 home-nursing support centers, 3200 health-maintenance centers, 30,000 nursing facilities, and 1000 medical institutions. NTT has been conducting field trials of its care-prevention system together with TelWel East and TelWel West since July 2005 at nursing facilities and other locations with the aim of evaluating the effectiveness of care-prevention instruction using information technology.

Targeting elderly persons for which care prevention is needed, the NTT Group will provide menus for scientifically proven exercise instruction and nutritional counseling using broadband and video-communication technologies. Our goal is to supplement the shortfall in qualified care-prevention counselors and expand the range of prevention services with the

overall objective of reducing the number of bedridden elderly persons and creating an energetic, healthy, and long-lived society.

For the future, we plan to expand our care-prevention system to include menus for oral hygiene, the prevention of cognitive problems, and other important health topics. Our desire is to provide a total-support system for the work and administration of care prevention.

#### References

- [1] <http://www8.cao.go.jp/kourei/whitepaper/w-2005/zenbun/17/index.html> (in Japanese).
- [2] T. Tsuboi, "A Care-Prevention System using Broadband Techniques (Version 1)," *Journal of the Japanese Society of Public Health*, Vol. 51, No. 10, Special Supplement, p. 676, 2004 (in Japanese).
- [3] T. Akanuma, T. Tsuboi, S. Hashimoto, T. Suzuki, and H. Kim, "Effectiveness of Broadband Techniques for Care-Prevention Work (Version 2)," *Journal of the Japanese Society of Public Health*, Vol. 51, No. 10, p. 677, 2004 (in Japanese).



**Setsuko Murata**

Senior Research Engineer, Promotion Project 1, NTT Cyber Solutions Laboratories.

She received the B.E. and Ph.D. degrees in electrical engineering from Keio University, Kanagawa in 1984 and 1999, respectively. In 1984, she joined the Electrical Communication Laboratories of Nippon Telegraph and Telephone Public Corporation (now NTT) and engaged in research on optical storage systems. She is currently involved in the area of health promotion and welfare systems for the elderly using broadband and video-communication technologies. She is a member of the Japanese Society of Public Health (JSPH).



**Kaori Fujimura**

Promotion Project 1, NTT Cyber Solutions Laboratories.

She received the B.E. and M.E. degrees in electrical engineering from Keio University, Kanagawa in 1994 and 1996, respectively. She joined NTT Human Interface Laboratories in 1996. In 1999 and 2002, she received the RSNA (Radiological Society of North America) Award of Certificate of Merit. She is a member of IEICE and JSPH.



**Toshiaki Tsuboi**

Senior Research Engineer, Supervisor, Promotion Project 1, NTT Cyber Solutions Laboratories.

He received the B.S. degree in physics from Kagoshima University, Kagoshima in 1980 and the M.S. degree in physics from Kyushu University, Fukuoka in 1982. In 1982, he joined the Electrical Communication Laboratories of Nippon Telegraph and Telephone Public Corporation (now NTT). He developed a speech recognition system for medical reports, a health promotion system, and a medical data sharing system. He is a member of the Institute of Electronics, Information and Communication Engineers (IEICE) of Japan, the Information Processing Society of Japan (IPSI), JSPH, and the Japan Society of Occupational Health.



**Hitomi Sato**

Human Interaction Project, NTT Cyber Solution Laboratories.

She received the B.A. degree in human sciences from Waseda University, Tokyo in 1997. She joined NTT Human Interface Laboratories, Tokyo in 1997.



**Tatsuaki Ito**

Promotion Project 1, NTT Cyber Solutions Laboratories.

He received the B.E. and M.E. degrees in information engineering from Shizuoka University, Shizuoka in 1993 and 1995, respectively. In 1995, he joined NTT Human Interface Laboratories, Kanagawa. He is engaged in the research of medical informatics.