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# TOTAL REHABILITATION RESEARCH

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## SHORT PAPERS

# Developing an ICT-based System to Support Care-dependent Older Persons to Continue to Live in Their Own Homes; User Interface Evaluation

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### ABSTRACT

As part of the development of a system to support care-dependent older persons to continue to live in their own homes using ICT for real-time monitoring, we evaluated the user interface of a developed web system, covering the ease of manipulating tablet terminals.

We asked 4 older persons living at home to use the web system for 4 weeks, and examined their impressions through a questionnaire survey. We also interviewed 3 facility staff members in charge to collect their opinions regarding the system. The ease of manipulating tablet terminals and contents of data output were generally satisfactory, but the data entry method had yet to be improved. In future studies, we will modify the prototype of this system, mainly improving the data entry method.

#### <Key-words>

ICT, care-dependent older persons, continuing to live in the home, web system, functional recovery care

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## I. BACKGROUND AND OBJECTIVE

Japan aims to establish the Community-based Integrated Care System by 2025, with the goal of helping people continue to live in the communities where they have long lived even if they become care-dependent. In this respect, the development of systems to help care-dependent older persons continue to live in their own homes is an important challenge. However, some previous studies reported that increased caregiving burdens upon their families due to declines in their activities of daily living (ADL), such as impaired excretory and social cognitive functions (Fukuda & Fukuda, 2011) or excretory system and mobility (Kikuchi, Minami & Shimanouchi, 2010; Makizako, Abe, Abe et al., 2008), make it difficult for them to continue to live in their own homes. On the other hand, comprehensive intervention provided through multi-professional approaches to improve the nutritional status and walking ability has been shown to prevent declines in ADL, and reduce families' caregiving burdens (Fujio, Ikuta, Miyashita et al., 2018; McCullagh, Brigstocke, Donaldson et al., 2005; Kalra, Evans, Perez et al., 2004). These findings indicate the necessity of supporting care-dependent older persons by maintaining/improving their ADL and consequently reducing caregiving burdens upon their families as measures to support these older persons to continue to live in their own homes.

With Grants-in-Aid for Scientific Research, we planned to develop a system that supports care-dependent older persons to continue to live in their own homes using information and communication technology (ICT) within a 3-year period from FY2016 to FY2018. The system should allow care-dependent older persons living at home or their families living with them to enter information needed for basic care approaches: hydration, nutrition, excretion, and exercise as part of functional recovery care (Takeuchi, 2017) through tablet terminals, and share it with care managers in charge. Using this system, it should become feasible to prevent declines in care-dependent older persons' ADL and reduce their families' caregiving burdens (Furukawa, Kodaira, Fujio et al., 2018). As we initially planned, we previously created a tentative web system for information-sharing. However, its usability for care-dependent older persons and their families without sufficient experience of using digital devices remained unclear. Therefore, we aim to create an improved prototype of this system, and confirm its usability through trial uses.

In the present study, we evaluated the user interface of the developed web system, covering the ease of manipulating tablet terminals, as part of the development of a system to support care-dependent older persons to continue to live in their own homes using ICT for real-time monitoring.

## II. DEFINITIONS OF TERMS

### 1. Functional recovery care

Functional recovery care is defined as “supporting individuals to achieve and improve/maintain their physical, mental, and social independence through care” (Takeuchi, 2017).

### 2. Basic care approaches

Functional recovery care is provided through basic care approaches, covering 4 important areas of health: hydration, nutrition, excretion, and exercise. These areas should be commonly addressed in any type of geriatric care (Takeuchi, 2017).

## III. METHODS

### 1. Participants

#### 1) Users (care-dependent older persons living at home)

We studied 4 older persons using a care facility and introduced to us by the person responsible for the facility as system “users”. All of them were living with their families. As their age and care grade might influence their ability to use devices, we collected information regarding these items as basic information with their consent. Table 1 provides basic information regarding the users.

<Table 1> Basic Information (Older Persons / Users)

User name	Age	Sex	Care grade	Long-term care service use
user01	82	Female	Not corresponding	None at present
user02	83	Female	Requiring level 2 support	Outpatient care services
user03	86	Female	Requiring level 2 support	Outpatient care services
user04	73	Male	Not corresponding	None at present

#### 2) Staff members in charge

We also involved 3 employees of the study facility as “staff” members in charge. These staff members had taken care of the users. Considering the influence of their age on device use as slight, we only examined their ages in 10-year increments, rather than exactly, when collecting basic information regarding them with their consent. We also clarified the lengths of their working experience in this category. Table 2 provides basic information regarding the staff members in charge.

<Table 2> Basic Information (Staff Members in Charge)

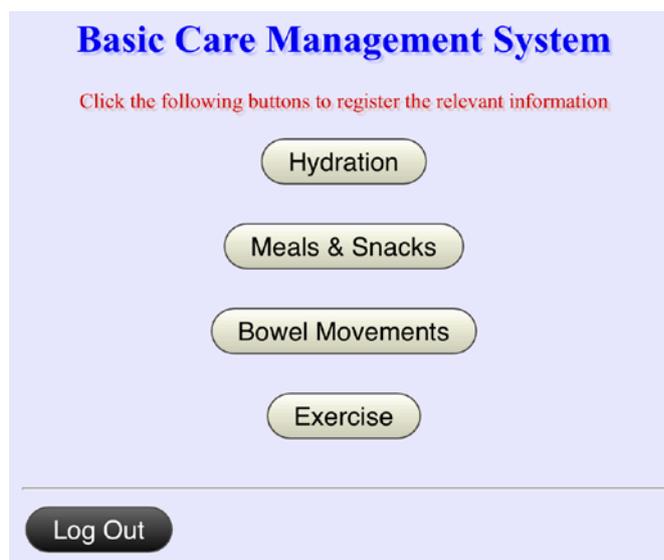
Staff name	Age in 10-year increments	Sex	Certification	Position	Total length of engagement in welfare/medical services	Length of employment in the current workplace
staff B	50s	Female	Nurse, Care manager, Dementia care specialist	Vice-chief	27 years and 3 months	25 years and 3 months
staff C	40s	Female	Certified care worker, Care manager	Group leader	18 years and 1 months	18 years and 1 months
staff D	30s	Female	Certified care worker		11 years and 2 months	11 years and 2 months

## 2. Study period

We collected data within a 4-week period between May 15 and June 30, 2018. Subsequently, on July 10, 2018, we interviewed the staff members in charge.

## 3. Items of monitoring using the web system

The system was designed to enter the following items of monitoring; in all cases, there was a box to freely describe the condition. The time of entry was automatically stored on a server. Figure 1 shows the <Top Page> screen.



<Figure 1> Top Page screen

### 1) Hydration

Figure 2 shows the <Hydration-related Data Entry> screen, with a description, indicating that collective data entry is also acceptable when it is difficult to enter data each time.

**Hydration**

Whenever possible, input the volume in each hydration session, and press the "Confirm" button.  
Batch registration for some hydration sessions may be allowable.  
In any case, press the "Send" button to complete the registration session.

---

Volume:  cc

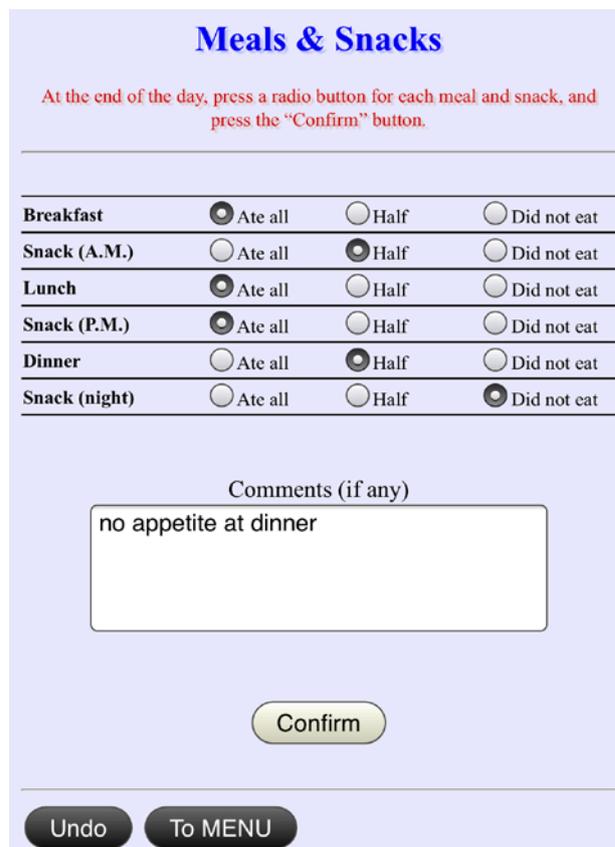
Comments (if any)

---

<Figure 2> Hydration-related Data Entry screen

## 2) Nutrition

Figure 3 shows the <Nutrition-related Data Entry> screen. Considering that the time of each meal is not so important in terms of basic care management, we instructed the users to enter data collectively at the end of each day.



**Meals & Snacks**

At the end of the day, press a radio button for each meal and snack, and press the "Confirm" button.

<b>Breakfast</b>	<input checked="" type="radio"/> Ate all	<input type="radio"/> Half	<input type="radio"/> Did not eat
<b>Snack (A.M.)</b>	<input type="radio"/> Ate all	<input checked="" type="radio"/> Half	<input type="radio"/> Did not eat
<b>Lunch</b>	<input checked="" type="radio"/> Ate all	<input type="radio"/> Half	<input type="radio"/> Did not eat
<b>Snack (P.M.)</b>	<input checked="" type="radio"/> Ate all	<input type="radio"/> Half	<input type="radio"/> Did not eat
<b>Dinner</b>	<input type="radio"/> Ate all	<input checked="" type="radio"/> Half	<input type="radio"/> Did not eat
<b>Snack (night)</b>	<input type="radio"/> Ate all	<input type="radio"/> Half	<input checked="" type="radio"/> Did not eat

Comments (if any)

no appetite at dinner

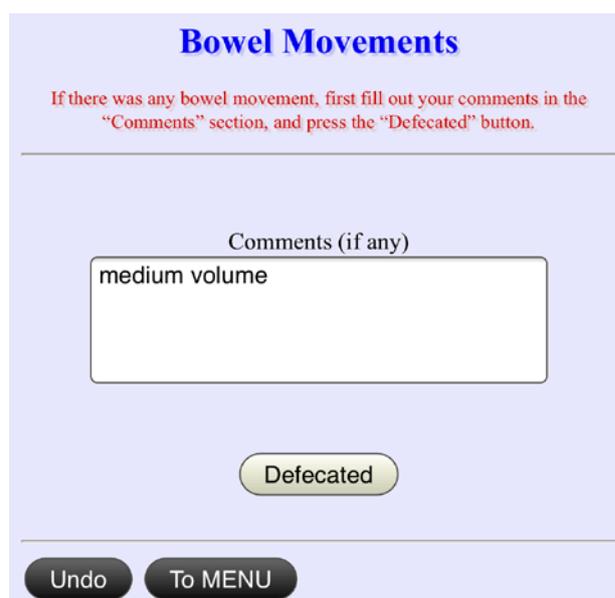
Confirm

Undo To MENU

<Figure 3> Nutrition-related Data Entry screen

### 3) Excretion

Figure 4 shows the <Excretion-related Data Entry> screen. As the time of each excretion is important in terms of basic care management, we instructed the users to click the button whenever they had excreted.



**Bowel Movements**

If there was any bowel movement, first fill out your comments in the "Comments" section, and press the "Defecated" button.

Comments (if any)

medium volume

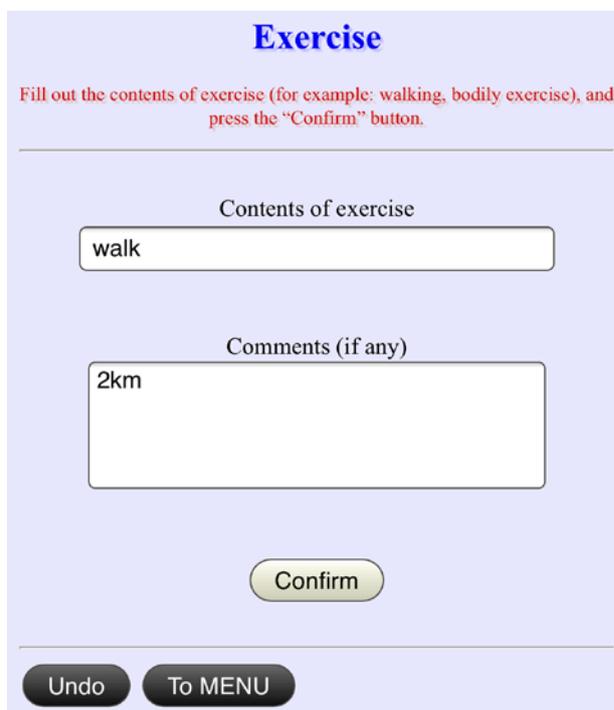
Defecated

Undo To MENU

<Figure 4> Excretion-related Data Entry screen

#### 4) Exercise

Figure 5 shows the <Exercise-related Data Entry> screen. As there are diverse contents of exercise, we instructed the users to freely describe the exercise they had performed.



The screenshot shows a data entry form titled "Exercise". The form has a light blue background. At the top, the word "Exercise" is written in blue. Below it, a red instruction reads: "Fill out the contents of exercise (for example: walking, bodily exercise), and press the "Confirm" button." There are two input fields: the first is labeled "Contents of exercise" and contains the text "walk"; the second is labeled "Comments (if any)" and contains the text "2km". At the bottom, there are three buttons: "Confirm" (yellow), "Undo" (black), and "To MENU" (black).

<Figure 5> Exercise-related Data Entry screen

#### 4. Data collection

1) We distributed tablet terminals (screen size: 10.1 inches) with Android 7.0 as an OS to the users: 4 care-dependent older persons, living at home, using a facility, and introduced by the person responsible for the facility.

2) We also distributed an operations manual we created to the staff members in charge, so that they would explain the basic method to manipulate the tablet terminals to the users.

3) As the web system was designed to be manipulated by older persons themselves, we instructed the users to enter data independently, and staff not to assist them with this.

4) We instructed the users to enter their fluid intake, diets, excretions, and level of exercise performed daily during the 4-week study period. We also asked them to enter their opinions regarding points to be improved and impressions in the free description box in all cases.

5) After the period of data entry, we conducted a questionnaire survey involving the users, with the following questions:

- (1) Who mainly entered these data?
- (2) Did you get used to manipulation soon?
- (3) Was it burdensome for you to enter data daily?
- (4) Please freely describe the difficulties you had when entering data.
- (5) Please freely describe the merits of data entry from your viewpoint.

6) We also interviewed the staff members in charge to collect their overall opinions regarding the study.

### **5. Analysis**

Based on the data entered by the users, those obtained through the questionnaire survey involving them, and those obtained through interviews with the staff members in charge, we evaluated the user interface upon deliberations with our collaborative researchers, focusing on the following 4 points:

- 1) Entire operating procedure
- 2) Legibility
- 3) Ease of data entry
- 4) Input assist functions

### **6. Ethical considerations**

With consent from the manager of the cooperating facility, we provided the participants with written and oral explanations of the study to obtain their written consent. We collected anonymized data, not containing any information that might allow the identification of individuals, such as names. We also previously obtained the approval of the Ethics Committee of Seirei Christopher University. (approval number: 17053)

## **IV. RESULTS AND DISCUSSION**

The ease of manipulating tablet terminals and contents of data output were generally satisfactory. According to the staff members in charge, the 4 basic care approaches used in the study were appropriate for ADL monitoring. The results regarding the study items are reported and discussed in the following sections.

### 1. Entire operating procedure

All users answered that they had entered data by themselves, supporting the ease of basically manipulating tablet terminals in the developed web system for older persons. Their responses to the questionnaire and the data obtained through interviews with the staff members in charge are outlined below:

#### *User 02*

- *I did not know what to do when I unintentionally touched a section of the screen, and it turned black.*

#### *User 03*

- *I did not understand English terms, such as 'login'.*
- *I did not know how to enlarge the screen display.*

#### *User 04*

- *Devices that are easier to manipulate may be more suitable for older persons.*

These comments indicate the necessity of creating a more detailed operations manual, previously explaining the method of manipulation, and establishing tools to help users when they face operational difficulties. They also suggest that the data entry method has yet to be improved by switching from text data entry to selection-type or voice data entry.

On the other hand, these points may not be major barriers to this development, as it is likely that the system will be used by generations who are more familiar with smartphones and personal computers in the future.

With regard to window-switching, the following comment was offered.

#### *User 01*

- *It would have been more helpful if it were possible to enter all data on the same page based on time, not items.*

This comment suggests that older persons prefer entering all necessary data on the same page as soon as they access the system, rather than switching from the <Top Page> screen to each page. We inserted explanatory notes into each page, but these notes can be omitted, and the system can be simplified by presenting a single page to enter all of the 4 items upon login. We will continue to examine the necessity of inserting explanatory notes into each page.

## 2. Legibility

We developed this system, inserting minimum necessary explanatory notes into each page, and increasing the text size as much as possible. Although text entry was feasible for all users, the text size may have been insufficient for some of them, according to the following comments:

### *User 03*

- *Letters were so small that they were illegible.*
- *It would have been better if letters could be enlarged.*

### *User 04*

- *The cursor was too small.*

### *Staff B*

- *It is desirable to increase the text size as much as possible.*

### *Staff C*

- *It is desirable to use slightly larger letters.*

Based on these opinions, the number of letters displayed should be reduced, and their size should be increased. However, as it is easy to increase the text size by pinching the screen out, it may be more effective to specify this in the operations manual or when explaining how to manipulate the devices.

## 3. Ease of data entry

We also considered presenting choices to simplify the method to enter hydration-related data. However, as the fluid intake might markedly vary among occasions, we finally decided on direct entry using a touch keyboard displayed on the screen. In contrast, we adopted a selection-type method to practically and conveniently enter diet-related data, regarding detailed data collection as unrealistic, although it might be ideal to clarify the details and nutrient content of each meal.

Three out of the 4 users answered that they became able to enter data by practicing for a few days, while 1 faced difficulty until the end. Based on their comments and information from the staff members in charge, selection-type data entry was feasible for all users, but text data entry was difficult for some of them until the end. To the question: <Was it burdensome for you to enter data daily?>, all of them answered that data entry was burdensome in the beginning, but it became easier when they got used to it. Thus, the burden of data entry may not have been so heavy, but the results revealed the necessity of considering reducing the number of items requiring text data entry and switching to selection-type data entry.

*User 01*

- *I prefer selection-type data entry.*

*User 03*

- *It would have been helpful if there were choices to enter exercise-related data, rather than text data entry.*

*User 04*

- *I think it will be helpful if voice input is also allowed when text data entry is difficult.*

*Staff C*

- *It is desirable to present choices as much as possible.*

#### **4. Input assist functions**

As for measures to be adopted when forgetting to enter data, there were the following comments:

*User 01*

- *It would have been helpful if it reminded me when I forgot to enter data.*
- *When I had forgotten to enter data, and entered them afterwards, I could not correct the time of data entry.*

*Staff B*

- *It is desirable for users to be able to enter data afterwards.*

We had also previously examined possibilities to allow users to enter data afterwards when they have forgotten, but we did not adopt this method to simplify operations as much as possible. We will continue to address this issue in our future studies.

In addition, there was the following comment:

*Staff B*

- *It would have been helpful if the order of clicking these buttons were also displayed on the screen.*

We inserted a description, instructing users to click the confirmation button after each entry, but numbering these buttons may make data entry easier, as a staff member noted. At the same time, this method may require additional explanation to clarify what these numbers are for. We will continue to address this issue in our future studies.

## 5. Others

The users also offered the following comments:

### *User 01*

- *My bowel movements improved when I began to pay attention to my fluid intake. I became aware of my own hydration and exercise levels each day.*

### *User 02*

- *Having learned how to basically use a tablet, I want to continue data entry.*
- *Data entry has been useful, because I began to pay more attention to my own physical condition.*

### *User 03*

- *I have learned the basic method to use a tablet.*
- *Recording has enhanced my awareness of hydration, and consequently resolved my constipation.*

### *User 04*

- *Data entry has been useful for me to recognize my own daily fluid intake.*

These comments do not directly regard user interface, but they support the usefulness of data entry. In other words, they may represent the users' satisfaction with the user interface of the developed system.

## V. CONCLUSION

With cooperation from 4 older persons living at home, we could take the first step toward the practical use of our system. On the other hand, the study has several limitations, and revealed multiple challenges.

First, the participants' level of care dependency was 'not corresponding (to any long-term care grade)' or 'requiring level 2 support'. Considering the necessity of involving older persons with more marked care dependency represented by care grade 4 or 5 in the future, we should further discuss methods to simplify and automatize data entry.

Second, the situation related to tablet terminal and Internet use is changing. It is expected that environments to use our system will markedly differ when generations with extensive experience of using tablets and smartphones become older. Therefore, we need to examine appropriate specifications, according to changes in the situation with time.

Device maintenance, tools to help operations, and systems to manage such tools are the

third challenge. Care managers and long-term care insurance-covered service providers are expected to prevent declines in ADL, and reduce family care-givers' burdens, but measures for device maintenance have yet to be developed.

Utilizing these findings and addressing the above-listed challenges, we will continue our studies toward the completion of a system to support care-dependent older persons to continue to live in their own homes.

### ACKNOWLEDGMENT

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