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An Information Sharing System for Multi-Professional Collaboration in the community-based integrated healthcare system

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A B S T R A C T S

Currently, Japan is rapidly aging. Japanese government agencies report that the percentage of elderly people whose ages are at least 65 years will increase by up to about 30 percent in 2025. As one of the measures towards this situation, the community-based integrated healthcare system will be introduced in Japan. The system aims to provide elderly people living at home with appropriate health, medical, and welfare services. We focus on the burden of sharing information on the situation of the elderly at home among health, medical, welfare staffs, and neighbors. We have been developing a supporting system for sharing information on the situation of the elderly at home and conducted a field test around one year. We consider that various stakeholders involved in the community comprehensive health care system could recognize the importance of information sharing and collaboration with them through this kind of social implementation.

1. INTRODUCTION

In recent years, Japan is aging. On October 1, 2018, the number of the population aged 65 and over was 35.58 million, accounting for 28.1% of the total population (aging rate) (Cao, 2019). The number of elderly people living alone is remarkable. The rate of males in the elderly population was 13.3%, and that of females was 21.1% in 2015. In addition, 42.2% of men and 30.2% of women over the age of 60 want to care at home. Against this background, the Ministry of Health, Labor and Welfare (MHLW) is promoting an integrated community-based healthcare system that allows older people to continue living their own lives at home and in their residential areas. The structure of the healthcare system is shown in Fig. 2. The public service provided depends on the situation of the elderly. The government aims to care for the elderly at home as much as possible. The government aims to reduce welfare costs. When an older person gets sick, he goes to the hospital or admits to the hospital. When the older person feels better, he returns home. When an older person needs a daycare service, he goes to the care or admits to the care home. When the older person feels better, he returns home.

In order to connect these services, organically, specialists engaged in healthcare, nursing, and welfare activities in the community should work in cooperation with each other (Abe et al., 2014). The Ministry of Health, Labor, and Welfare also mentions the importance of multi-professional cooperation in-home healthcare in the community-based integrated healthcare system. In order to promote multi-professional collaboration, community care meetings are introduced in the healthcare system. The meetings aim at improving the support of the elderly and improving the social infrastructure, i.e., community improvement (John et al). Namely, the care meetings play a role of sharing information of the elderly in-home care. The whole stakeholders should involve in the care meeting to share the information more detailed. However, that is not realistic because they are usually under a high workload. In this research, we aim to support multi-professional collaboration in-home care of an integrated community-based healthcare system using an information-sharing system based on ICT. We consider that the information-sharing system has advantages as follows:

• Grasping the situation of the elderly property.

• Providing the elderly with adequate care services at the proper timing.

We have developed an information-sharing system for multi-professional collaboration in the community-based integrated healthcare system. In this paper, we introduce an information-sharing system for multi-professional collaboration in the community-based integrated healthcare system. In order to evaluate those issues, we conduct a field test in Nomi city, Ishikawa Prefecture, Japan.
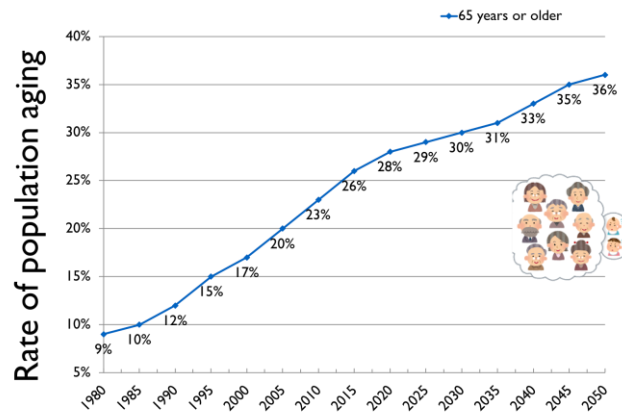
Fig. 1. Rate of Population Aging in Japan. Annual Report by Japanese Ministry of Health, Labour and Welfare (Mhlw) Fy2019

2. RELATED WORKS

Currently, ICT is used to support multi professional cooperation and support for caregivers. The following section introduces researches on support for multi-professional collaboration in medical care and nursing care, and support for caregivers.
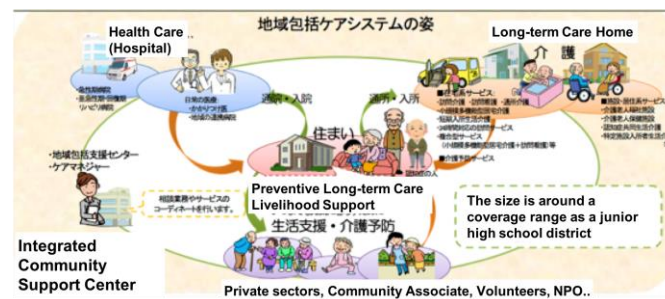

Fig. 2. Community-based integrated healthcare system in Japan. Annual report by Japanese Ministry of Health, Labour and Welfare (MHLW) FY2019

A. Multi-professional collaboration in home care

Amir et al. clarified the characteristics of a multidisciplinary care team, including a family doctor, a home nurse, and a neurologist, for the care of children with chronic diseases such as developmental disorders (Amir et al., 2015). This study suggests that problems such as inadequate communication, such as difficulty in coordinating care between members of the care team and setting goals for treatment with family members. One of the reasons for this problem is that the activities of health care workers and caregivers are loosely coupled and weakly interdependent (Pinelle et al., 2006). Therefore, it is important that health care workers and caregivers can recognize each other's activities.

Yamamoto et al. have developed a patient information sharing system

among multi-professional healthcare professionals for home healthcare collaboration (Yamamoto et al., 2018). This system has a patient information sharing function, healthcare worker information sharing function, and text chat. These functions are useful for sharing information among multiprofessional medical staff belonging to different medical institutions. This study shows medical staff belonging to core hospital Elderly people have shown interest in information other than records registered by healthcare professionals belonging to different organizations, and the possibility of smooth medical cooperation through the notification function. This system is not intended for family or patient use. Therefore, it is considered difficult to obtain requests and consultations from family members and to obtain home information from the family's point of view.

In this study, the information sharing system using ICT is used not only by medical and nursing care workers but also by the elderly family members. Our system aims that communication between medical professionals and family members could be activated.

B.   Support for family caregivers

There are some researches that use ICT to support caregivers. Duncan et al. developed a monitoring system for elder care [7]. The system installs sensors and cameras at the entrance to the elderly's residence. The system takes a photograph of the person at the entrance when the doorbell rings, or open and sent it as an image message to the caregiver's mobile phone. The system enables caregivers to reduce the cognitive load for confirming the elderly going out and visiting people from remote places. As a result, they improve the care and quality of life for the elderly.

As psychological support for family caregivers, Yamashita et al. clarified the stress nature and needs of family caregivers with depressed patients and their demands for social relationships with others (Yamashita et al., 2013). Based on these findings, they developed a Web application for nursing records to support family caregivers of depressed patients (Yamashita et al., 2017). Family caregivers can use the Web application to record daily activities and moods of depressed patients, record the activities of family caregivers, and facilitate family caregiver reflection analysis. This application clarified that the communication between patients and family caregivers could be activated.

In this study, information that is usually difficult to know, such as the activity and physical condition of the elderly at home, is shared not only with health care professionals but also with especially distant families.

3. INITIATIVES FOR HOME-MEDICAL COOPERATION OF THE COMMUNITY-BASED INTEGRATED HEALTHCARE SYSTEM IN THE TARGET FIELD

In this paper, we introduce an information-sharing system for multi-professional collaboration in the community based integrated healthcare system. We conduct a field test of the system in Nomi city, Ishikawa Prefecture, Japan. The following is the introduction of Nomi city and its home medical cooperation.

A.   Overview of Nomi City, Ishikawa Prefecture

As of 2015, Nomi City, Ishikawa Prefecture, had a population of 48,881, and the population aged 65 and over is 11,983 (Stat.go.jp, 2020). According to the Japan Medical Association, the aging rate in Nomi City, Ishikawa Prefecture in 2015, was 24.5% (national average 26.3%). The number of doctors per 100,000 populations is 147.30 (national average 230.56), and the number of nurses and nursing staff is 29.56 (national average 18.17) and 109.33 (national average 93.02), respectively. The total number of nursing homes is about 15% higher than the national average. In Nomi, Ishikawa, there are more caregivers than medical staff.

B.   Multi-professional cooperation among home-basedmedical care in Nomi City

In this research, we collaborate with a community care conference on "medical care and nursing care cooperation" organized by a promotion organization of multiprofessional cooperation in Nomi: "Memory Care Network Nomi." We investigate problems in-home medical care cooperation and develop and introduce an informationsharing system.

The activities of this "medical and nursing care cooperation" are classified into two categories, "multi-occupation coordination meeting" and "home care utilizing ICT". "Multi-professional coordination meeting" is divided into "regional meeting" and "on-site meeting." At the regional meetings, various stakeholders, such as doctors, caregivers, and elderly support center staff participate. At the regional meeting,

activity reports in the three districts of Nomi City, reports on the contents of on-site meetings, and discussions on the operation and functions of an information-sharing system using ICT will be held. In the on-site meeting, family caregivers participate in addition to the stakeholders in each of the field districts. They confirm their opinions and reports on what they want to share.

The on-site meeting is held once a month. In "Home care using ICT," elderly people in target field districts are monitored using the information-sharing system introduced. The contents monitored by each professional are input to the system and shared among professionals.

4.   INFORMATION-SHARING SYSTEM: MCNBOOKSYSTEM

A. System Overview

We have developed an information-sharing system "MCNBookSystem" to support multi-professional collaboration in the community-based integrated healthcare system. We conduct a field test in Nomi City, Ishikawa Prefecture, Japan. Fig. 3 shows the configuration of this system. MCNBookSystem aims to facilitate the sharing of information among medical professionals of different affiliated organizations and family members. Medical and nursing care workers, including family caregivers, input information they have noticed from the state and conversation of the elderly into the system and share the information with other professionals using devices such as smartphones, tablets, and personal computers via the Internet. The items to be shared are as follows. Each item is entered as an arbitrary level. For example, a status of temperature is represented as "Extreme fever and need

to contact with medical professional," "High fever," "A little fever rather than normal," "Nomal." (Fig. 2).

- Physical condition: Temperature (4 Levels), Blood pressure (4 Levels), Dullness (4 Levels) and Excretion status (4 Levels)
- Intake status: Drug (3 levels), Meal (4 levels) and Water (3 levels)
- Activity: Going out (4 levels), Exercise, Independence of cooking (4 levels), Independence of excretion (4 levels) and Exercise (3 levels)
- Living situation: Sleep (4 levels), Communication (4 levels), and Garbage disposal (4 levels)
- Features on individuals: items according to the characteristics of the target. Ex.,Levels of back-pain
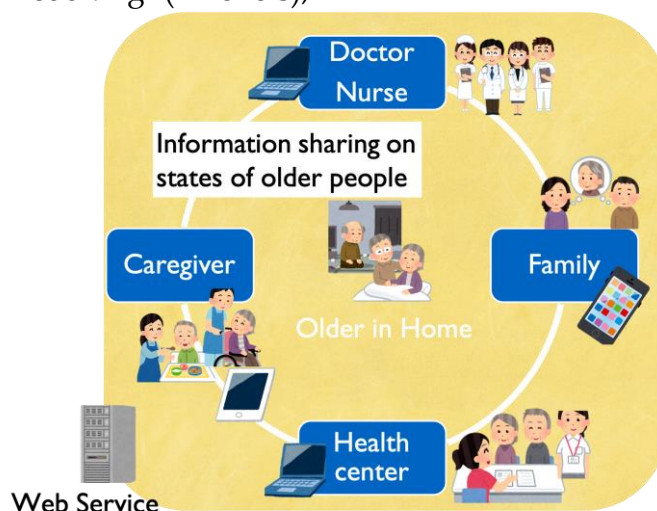- Involved Member: Family members, Contact list and stakeholders

Fig. 3. System Structure

B. Functions for the information-sharing system

The system supports multi-professional collaboration in home care by the following functions.

- Function of sharing elderly situation
- Function of sharing messages
- Function of altering changes in elderly status

In the function of sharing elderly situation, users can input and access the shared items mentioned above. In order to make it easier for users to enter and confirm the status of the elderly, the information is displayed and shared in four stages: "Emergency", "Caution," "Attention" and "Normal" (Fig. 5). Users also can trace the history of these statuses (Fig. 6). In the function of sharing messages, users can communicate with messages among them like SNS (Fig. 7). Users get to know the status of the elderly except for shared items, and advice and instructions from others. Users also can attach image files on each message in order to share handwritten care record documents, diseased area and activity (Fig. 8). In the function of alerting changes in elderly status, the system can alert the pre-registered persons when there are changes in the situation of the elderly. The criteria of the alert are based

on some rules of an individual. For example, some statuses became "Emergency," and the situation

continues after fifth observation in succession.

Fig. 4. Screen image: Inputting shared system

Fig. 5. Screen image: each status of the elder displayed as four stages: "Emergency", "Caution," "Attention" and "Normal"

Fig. 6. Screen image: history of statuses of the elderly

Fig. 7. Screen image: sharing messages like SNS

5. A FILED TEST OF THE SYSTEM

We conducted a field test of the system in three districts of Nomi city. The number of subjects are six elderly persons.

A. Subjects

The subjects of the test are elderly people in 70s and 80s. The start of operation of the system differs each subject due to each subject's circumstances. Table 1 shows the subject's information on the kick-off date of operation, the household situation, the level of care needed, the degree of independence of the elderly with dementia, and stakeholders of in-home care. Subject A and B live in the first district, Subject C and D live in the second district, and Subject E and F live in the third district.

B. System usage logs in the field test

We analyzed system usage logs for three districts where this system has been installed. There are two subjects in each district. The responsible persons are a doctor "Doctor A" who is in charge of the first district, a doctor "Doctor B" who is in charge of the second district, and a doctor "Doctor D" and a care manager "Care manager XX" who are in charge of the third district. Table 1, Table 2 and Table 4 show usage logs whose stakeholders for subjects in each district. They are the totaled results of usage logs from the start of using the system until September 30th, 2017. For example, Table II shows that there are one doctor "Doctor A," three family members "Family-1, Family-2 and Family-3," one care center, one care manager, one care house, and one home helper for Subject A, and these usages logs. According to Table II and Table IV, there are some users who had never used the system since the number of logins is 0. On the other hand, tThere are most of the users who tended to confirm the status of subjects and messages frequently. we found that households living together tended to share information due to "Emergency" or "Caution", and households living alone tended to share messages.

6. INTERVIEW SURVEY

We interviewed with system users of the filed tests. Through the interview, we investigated the following things:

- Situation of multi-professional cooperation before the introduction of the system
- Changes in care and work after the introduction of the system.
- Changes in the elderly after the introduction of the system The following results are based on stakeholders of "Subject A." "Doctor A" is a family doctor of the subject.

Table 1. Usage logs whose stakeholders for subjects in each district

Subject (Age)	Kick-off date	Household situation	Level of care needed (5 Levels)	Degree of independence of the elderly with dementia (8 levels)	Stakeholders of in-home care
A:80s	May 31th,2017	Alone	3	None	Family,Doctor,Care Manager, Center,Care house
B:80s	Nov 1st,2016	Child, Wife of Child	1	6	Family,Doctor,Care Manager, Center,Care house (2 places)
C:80s	May 8th, 2017	Wife, Cild	3	7	Family,Doctor,Care Manager, Center,Care house (2 places), Neighbor
D:70s	Dec 26th, 2016	Wife	1	3	Family, Care Manager, Center,Care house, Neighbor
E:80s	Dec 20th, 2016	Alone	1	None	Family,Doctor,Care Manager, Center,Care house
F:80s	Dec 12th, 2016	Alone	1	None	Family,Doctor,Care Manager, Center,Care house

Fig. 8. Attached Image Files on Each Message: Handwritten Care Record Documents, Diseased Area and Activity

A. Situation of multi-professional cooperation before the introduction of the system

"DoctorA"commented,"Theonlywaytocontactother professionals was to contact them by phone or in-person instead of e-mail, and the information of the elderly alone was available only during consultation hours. " And the doctor commented, "As a result, I did not know the medical information from other medical institutions, and caregivers or care managers may decide the care policy and service without consulting with me." "Care Manager A" commented, "Care managers have a central role and must contact with other stakeholders frequently. However, the only time I can meet the family doctor is the elderly's consultation hours, and the way to know the situation of the elderly is only a monthly report from the nursing care

establishment. Hence, I cannot discuss it with other professionals elaborately."

Moreover, the care manager commented, "I have many elderly persons whom I am in charge of, and have to visit, especially those living alone twice a week. I have to spend much time and effort to understand what elderly people with dementia say. I usually contact some issues of elderly persons with a care center once a month. I end up to deal with them even if I report them." "Family-1" commented, "Before using the system, we visit the elderly without staying a once a week or ten days since we live a distance from the elderly.

The actual situation was usually different from what I had heard about the elderly and the house from the elderly. We frequently contact the family doctor and the care manager difficulty due to time

issues, and We are vaguely anxious about this situation." According to these comments, we find that it was difficult to contact each other before the introduction of the system. And we consider that information on the elderly could only be obtained incompletely among the whole stakeholders. The stakeholders can perform appropriate interventions in the elderly difficultly. The families consulted with the professionals and did not know the appropriate response. Hence, we consider that inappropriate care policies and services could be set possibly.

B. Changes in care and work after the introduction of the system

The care house commented, "We have only information about what the elderly act in the care house twice a week. Using the system, we can get to know the meals and medicines at home and understand that what we need to pay attention to." The home helper commented, "I know the situation at home, and thoughts of the elderly's family more clearly. In a case that I would like to know the situation of the elderly at home, which other professionals have, I had no choice but asking the care manager about it. The situation information becomes available to me. At my staff meeting, I can inform other staff members of the information other professionals have, which could not be shared." The care manager commented, "It is effortless to realize what to should care for and tell the family since we can access the current situation and information of the elderly in the system. As a care manager, the number of visits to the subject decreased. I used to visit a family doctor, care house, and the elderly's household; however, now, I only need to go to the care house or the elderly's household once a week". The family commented, "My younger brother's wife is also checking on the system, and she can come to the house at a time when she is worried. She can know the proper timing to visit." In the logs of "Subject A" in Table II, the whole stakeholders frequently use the system. According to the number of checking the information, they emphasize to sharing information among them.

"Family-1" commented, "There is a note of caring for the elderly in a care house. I have to visit the care house in order to contact the note. Using the system, I can check the note in the system. I realize that the staffs care for the elderly carefully. I should input the current situation of the elderly firmly. I would like to input the state of the elderly of the house and the contents of the conversation with the elderly as much as possible. I am not worried about the elderly because a family doctor and other professionals can care for the elderly and give some advice depending on the current situation of the elderly". From these comments, we consider that the active monitoring by multi-professionals was a kind of "trigger" that encouraged family members sharing information.

C. Changes in the elderly after the introduction of the system

We find that "Subject A" changed after the introduction of the system." For example, "Family A" repeatedly said to "Subject A" that many people keep observing and caring for you and observing various. As a result, it seems that Subject A gradually began to be aware of this situation. "Family A" commented, "There are some sensors to recognize whether "Subject A" lives a regular life based on his motion or not. In a case that the sensors do not recognize it, the sensors alert to the home helper.

Before the introduction of the system, the alter often occurs. Since "Subject A" changes to live a regular life" after the introduction of the system, the number of alerts decreased. "Subject A" commented: "I feel that family and other people watch over. So, I began to live a regular life." This change in the subject is one of the good effects on the elderly person. We consider that the system fosters multi-professional collaboration, and the quality of care improves.

7. DISCUSSION

In the following, we discuss the effects of using the MCNBookSystem on multi-professional collaboration in-home care and future directions based on these considerations.

A. Effects on multi-professional collaboration in-home care

The analysis using the logs and interview surveys reveals that the effects of cooperation among the whole stakeholders including family members using the system as follows:

It is possible to grasp the state of the elderly at home, which had been difficult to confirm, to find out and share problems unique to the elderly. • It is possible to obtain detailed information of the elderly through the function of information sharing of this system and reduce the effort of care: i.e., the number of visits among the professionals and the elderly's homes. The result shows that professionals could care for more elderly people.

• It is useful for reducing the burden on care managers who play a central role in cooperation among other professionals, including family members, and improving efficiency by utilizing information from them.

• The family members were encouraged to input and share the state of the elderly at home because they understand that they could grasp the exact situation of the elderly and obtain the appropriate advice from the professionals through the system.

• The input of the information by the whole stakeholders led to the reduction of their burden and the improvement of care.

Thus, we consider that the information-sharing by the whole professionals not only improves care for the elderly, but also has the effect of reducing work load and increasing efficiency, and promoting the sharing of information with the elderly's families.

B. Difference in the usage status of this system for each household

Compared to the first district in Table 2 and the third one in Table 4, the use of this system seems to be less in the second one in Table 3. "Care manager of Subject A" commented that "multi-professional collaboration using such an information-sharing system would not be successful if only medical professionals used." We consider that one of the reasons is that there is little information from family members of the elderly.

Comparing Table 2 and Table 3, the use of the system by family members of "Subject C" is less than the use by ones of "Subject A" even though family members of Subject C started operation of this system at the same time as ones of Subject A. We consider that there is a relation ship between the usage by the family

members and one by professionals. Namely, as the use by the family increase, the information-sharing by the whole stakeholders would activate. Therefore, we consider that it is important to regard family members as members of multi-professionals and to actively share information with each other in multi professional collaboration.

Doctor B inputs the situation more frequently than other doctors but has less input and confirmation of messages. Doctor A stated: "the number of inputs depends on the purpose of the usage. If a doctor who has a strong relationship with medical information inputs a message, a care manager who wants the information will inevitably input and confirm messages. We consider that the sharing of medical information by doctors is one of the factors of active information sharing.

C. Effects and effects on the elderly

We consider that the system fosters multi-professional collaboration using information sharing among the whole stakeholders. We find that the system also had a positive effect on the elderly who were watched over. For example, Subject A said, "I feel that family and other people watch over. So, I began to live a regular life." We consider that the system provides the elderly with a kind of awareness of health.

D. Issues of the system

We consider that specifying the degree of importance enables users to grasp essential messages at a glance, and contributes to more precise information sharing. On the other hand, it is not easy for stakeholders, especially family members, to set appropriate importance for each message. It is necessary to

carefully consider whether they will avoid the input operation itself due to the complexity of the work and the increase in the amount of work. In a case that high importance set in a message, the stakeholders might have a kind of sense of duty toward dealing with it urgently. This sense increases such a burden to the stake holders that they might avoid using message-sharing. We consider the balance between the improvement of the function and the increase in the burden. In the future, we will pay careful attention to the impact on the field use in order to improve

8. CONCLUSION

In this paper, we introduce an information-sharing system to support multi-professional collaboration in the community-based integrated healthcare system We conducted a filed test of the system in three districts of Nomi City, Ishikawa Prefecture, Japan. According to an analysis of the system usage logs and an interview survey, it is found that the information-sharing system was effective in reducing the burden on professionals such as care managers and improving efficiency. It is also found that active information sharing by professionals promotes activities of confirming and inputting messages for elderly family members. Also, the elderly were aware that the stakeholders watch over them carefully. The awareness had the effect of making their daily life regular. From these results, we consider that the use of the system makes it possible to share the information which was difficultly shared among the whole stake holders, and shows the possibility of promoting the health of the elderly themselves. the system.

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