Resource Consumption and Functional Deterioration in Elderly Care

- Introduction a Typology of Aged Inpatients (TAI) -

Tai Takahashi, Ph.D.*, Karin A. Dumbaugh, D.Sc.*, Michael Reich, Ph.D.*

* From the Department of International Health, Harvard School of Public Health, Boston M.A.

Address correspondence to: Tai Takahashi, Ph.D., Latest Address: Computer Center, University of Tokyo Hospital, 7-3-1 Hongou Bunkyou-ku, Tokyo 113, Japan

(Abstract)

The social and financial impact of the increasing demand for elderly care calls for scientific measures. We developed a new multipurpose instruments for long term care named Typology of Aged Inpatients (TAI) for classifying patients by functional status and their resource consumption. 229 nurses and 367 care-givers in 11 long term facilities in Japan were allotted a time-keeper, who observed a staff member, measured the duration of time with a stop-watch. A total of 341,832 service minutes and 1,260 patients' functional data were utilized for developing TAI. TAI classifies elderly people into one of 12 elderly types. This classification explained 63.0% of the variance of Direct Service time. Compared with previous instruments, the framework of TAI emphasizes the longitudinal functional change of the elderly, and is a more dynamic model. This advantage of TAI makes it easy for staff to recognize and predict the longitudinal change of inpatients. Because very limited data collection required for the use of TAI, TAI is less time consuming.

(key word) Resource Utilization, Long-term care, Measurements, Functional Deterioration,
Resource Consumption and Functional Deterioration in Elderly Care

- Introduction a Typology of Aged Inpatients (TAI) -

1. Introduction

As the rapidly expanding aged population requires increasing social supports in most developed countries, universal insurance coverage for elderly care is being planed by the Japanese government. Elderly care has been rarely evaluated with objective methods in Japan. The social and financial impact of the increasing demand for elderly care calls for scientific measurements and instruments in order to assure the quality of the service and to optimize the distribution of social funds to various kinds of services for the aged.

This report describes one method of classifying patients by functional status and their resource consumption, using a new multipurpose instruments for long term care named Typology of Aged Inpatients (TAI). Compared with previous instruments, TAI emphasizes the longitudinal functional change of the elderly in the framework, and is a more dynamic model. This advantage of TAI makes it easy for staff to recognize and predict the longitudinal change of inpatients. Because TAI requires limited data collection of only four measures of functional status and one of medical status, TAI is less time consuming. There are two purposes in this paper. The first one is to introduce TAI. The second purpose is to explain how functional status affects the resource level required and to display the longitudinal functional deterioration processes and the corresponding resource level in the discussion.

2. Background

In current use are two types of measures related to elderly care: function based measures and resource oriented ones. Examples of measures for evaluating the functional level of the aged are the Katz Index of ADL1 adopted in Minimum Data Sets2, the Barthel Index3, the FIM4. These are especially useful for quality assurance. RUGs III5 (Resource Utilization Groups version III) is the most well known resource based instrument. It explains the resource consumption level for providing care in long term
facilities in the U.S. As the theoretical basis for the reimbursement to Medicaid patients in long term facilities, some states in the U.S. have adopted several resource oriented measures6-8.

Because functions and resource consumption, which had been separately evaluated, seemed to have a strong correlation, the SFC (Status Function and Care) method 9-10 was developed by means of intensive and repeated interviews to care-givers, to numerically reflect the relationship between the functional status of the elderly and the burden of care provided. With the SFC, a score for the burden of care (excluding medical and rehabilitation services) can be estimated by using only four kinds of functional measures (SFC measures) mental status, mobility, eating, and toilet. TAI was developed on the basis of the SFC method by way of confirming the empirical (qualitative) opinions of care-givers with the quantitative data.

3. Method

3.1. Construction of database

The procedure for constructing the database is shown in Fig. 1. In order to record every service provided in 11 long term facilities in Japan (4 Hospitals (14 units), 2 Intermediate Facilities (5 units) and 5 Nursing Homes (10 units)), all staff (229 nurses and 367 care-givers) in these units were allotted a time-keeper from the beginning to the end of her/his working time. A time-keeper observed a staff member, measured the duration of time with a stop-watch and recorded (1) Service content (according to service category such as (a) Meal, (b) Toilet, (c) Bath, (d) Hygiene, (e) Environmental, (f) Mental, (g) Transfer, (h) Medical & Rehabilitation, (i) Information, and (j) Rest & Waiting), (2) Duration of time for providing a service, and (3) Patient I.D. when service was provided directly to a patient. These time sampling studies were performed for 48 hours (2 days) in 8 facilities, and a 24 hour study was carried out in 2 facilities, and in one facility 3 out of 5 units were observed for 24 hours and 2 out of 5 units could be studied for 48 hours. A total of 341,832 service minutes was recorded. Patients, who were in the facility for 48 hours during the 2 day survey, were dealt with as 2 samples. During the data collection, 1,260 patients (2 day sample :1,029, 1 day sample : 231) were staying in long term facilities and 2,289 samples could be collected. Although time-keepers were allotted to staff members, Direct Service provided face to
face to a specific patient, such as spoon feeding, diaper changes, conversation, and medical observation of a specific patient, could be identified by sorting all data by the patients' ID numbers. The resource consumption data (Fig. 1) illustrates the categorized summation time of every Direct Service provided to a specific patient in the survey day. Indirect Service includes all services except Direct Service such as a routine patrol of the unit, charting, rest and waiting and so on. In this paper, only Direct Service is focused on and the relationship between Direct Services (105,360 min.) and functional status of patients are analyzed. The relationship between Indirect Service (236,472 min.) and Direct Service is discussed in another paper titled 'Mechanism of Resource Allocation in Elderly Care'. The detail related to the reliability of this resource consumption data are contained in Appendix A.

Data items collected on patients (Fig.1) were (1) Basic data (i.e.: patient I.D., sex, age), (2) Typical ADL measures (some parts of MDS including the Katz Index of ADL, FIM, and TAI measures), (3) Daily life data (i.e. : meal place, wheel chair), (4) Medical status. Medical status of patients who required acute or intensive medical care was reported by nurses at the same day when the time study was performed. The other items were collected within one week after the time sampling study by questionnaires completed by staff members working in the unit.

3.2. Designing framework of TAI

Four kinds of TAI measures of functional status of the elderly (Fig. 2-1 to Fig. 2-4) could be constructed by simplifying the four kinds of SFC measures; resulting in 6 categories of patients from 5 (Independent) to 0 (Severely deteriorated).

The initial plan for forming major categories was to classify elderly people into one of four major categories (displayed at the upper left corner of Fig 3). Then Group No. 1, which was mobile and cognitively intact, was named the border group, and group No. 2, which was mobile but cognitively deteriorated, was named the mobile confused group (displayed at the lower left corner of Fig 3). The immobile group was formed by combining group No. 3 with group No. 4, because the sample number of group No. 3 had an insufficient number of samples for making a major group, and because all patients in group No. 3 and No. 4, who were immobile, caused a similar level of resources regardless of mental status
as shown in the chapter on the results. From the data we also concluded that residents requiring high resource consumption in terms of medical service should be grouped separately as outliers, and the medical group was newly formed as one of the major categories.

The additional classification separated every major category into three types by means of the resource consumption level. Consequently, the final framework for typing the elderly people was completed (Table shown at the right side of Fig. 3).

3.3. Defining Major Categories and Elderly Types (How to decide Cut-off Point)

After deciding the framework of TAI, the remaining task was to decide the classification criteria of the major categories and the elderly types. In this study, 180 potential criteria for deciding major categories (Border, Mobile Confused, and Immobile) were prepared, and 180 analyses of variance ($r^2$) were performed with the formula as shown below.

\[
(r^2) = \frac{\text{SS}_{	ext{model}} - \text{SS}_{	ext{error}}}{\text{SS}_{	ext{total}}}
\]

($n$= number of Total sample, $i$= one of Border group, $j$= one of Mobile Confused, $k$= one of Immobile)

The criterion with the greatest explanatory variance was selected as the final criterion for defining the major category.

For deciding the criteria to define three levels of sub-categories (High - Medium - Low resource consumption levels), 400 kinds of potential criteria in each major category (total 1,200 kinds of potential criteria) were nominated. With these criteria, 1200 explanatory variances were also calculated. The criteria which maximized the size of the explanatory variance of the TAI model were adopted as the final criteria for deciding the sub-categories. The sub-categories of the medical group classified according to the specific medical definition (Fig. 4) rather than according to the resource use. The detail of these procedures was discussed in Appendix B.
4. Result.

4.1. Introduction of TAI

By way of the process shown above, the Typology of Aged Inpatients (TAI), as shown in Fig. 4, was developed. This instrument classifies the elderly people into one of the 12 elderly types. First, a major category is assigned. The inpatients, who consume a large quantity of medical service, are initially selected as outliers and assigned to the Medical group. The elderly people, whose 'TAI mobility level is 3 or more' and 'TAI Mental level is 4 or 5', are defined as the Border group. The elderly, whose 'TAI mobility level is 3 or more' and 'TAI Mental level is 3 or less' are regarded as the Mobile Confused. The patients whose 'TAI mobility level is 2 or less' are classified into the Immobile group. Next, the secondary classification is performed by the resource consumption level, and every inpatient in each major groups are classified into one type among low - medium - high resource consumption types. Although the secondary classification is based on the resource consumption level, the average ADL level is descending in proportion to the increase of the resource consumption level, as shown in detail later. The first character of an elderly type represents a major category (B : Border, C : mobile Confused, I : Immobile, M : Medical). A sub-category number of an elderly type displays the total ADL level from 5 (Independent) to 0 (Fully dependent), which is explained in the chapter on discussion. As the 'M-A (Medical Acute)' and the 'M-I (medical Intensive)' in the medical group are dealt with as the exceptional types, these two types are not assigned a sub-category number. When a sub-category number is decreasing, an average function is declining and a resource consumption level required is rising except in the transition from I-1 to M-0. For instance, a C-2 type patient, who requires both toilet support and spoon feeding, can be regarded as more functionally deteriorated and more resource consuming compared with a C-3 type inpatient, who needs either toilet support or spoon feeding.

Direct time includes all services provided face to face to patients and is equivalent to Daily time plus Medical time. Daily time includes meal, toilet, bathing, hygiene, environment, mental and transfer service time. Because the average Direct time consumed by the independent patients (B-5) was 6.8 min., 6.8 min. is regarded as a resource consumption unit later. The ratio of 'the Direct time of each group' divided by '6.8 min. (a unit time)' is called to be Care Requirement Index (CRI), which indicates an
approximate burden of care when staff members provide him or her with care service. The average CRI of the samples of this study was 6.8 (which was coincidentally the same number of the average Direct time consumed by B-5), because the average Direct time consumption in this study was 46.0 minutes and 6.8 minutes were consumed by B-5 patients (6.8 = 46.0 / 6.8). As the CRI of M-I was 51.6 (= 351.2 min. / 6.8 min.), there was more than 50 fold difference in the level of resource consumption between the maximum resource consumption type (M-I) and minimum resource consumption type (B-5). 63.0% of the variance of the Direct time consumption and the 49.4% of the variance of the Daily time in this study could be explained by this instrument. The predictive validity of TAI is discussed in Appendix C.

4.2. Elderly Type and Resource Consumption

The Direct time consumption in every elderly type is illustrated (Fig. 5) as the form of the summation of daily plus medical time consumption. Because elderly types were decided by means of maximizing the explanatory variance of the Direct time consumption in each major groups, the average of Direct time consumption is of course increasing within the same major category when the subcategory number is decreasing. As the average medical service time was 7.9 minutes in this study (Tab.1), only 17.2% (= 7.9 min. / 46.0 min.) of the Direct time was consumed for providing medical service. But because the variance of medical service was much greater than that of daily service (Fig. 5), the medical group was dealt with as outliers when the major category groups were constructed.

The average time consumption in almost all service segments was increasing as a sub-category number decreased (Tab. 1) such as the meal service in the Border group from 0.4 minutes to 0.8 minutes and to 1.7 minutes. B-4 patients don't require both eating supports and toilet supports according to the definition of B-4, and the definition of B-3 indicates that B-3 patients require eating supports or toilet supports. This functional difference causes the remarkable jump up of the toilet service time between B-4 and B-3 from 1.1 minutes to 13.3 minutes. Since C-4 (Mobile Confused-4) patients can eat and can go to toilet on their own ability, whereas C-3 patients require either eating supports or toilet supports, the average toilet service time vastly differs between C-4 type and C-3 type (2.3 min. vs. 14.3 min.). Because C-2 patients need both feeding aids and toilet aids, meal service time sharply rises up from 2.7 min. to
According to the decrease of the sub-category number from 3 to 1 in the immobile group, feeding status is changing from 'no needs for eating support' to 'easy spoon feeding' and to 'difficult and risky feeding support'. This is why the meal service time is enlarging from 4.1 min. to 13.3 min. and to 32.5 min. Because almost all patients in the Immobile group require diaper changes, the average toilet service time has small variance among three types (13.6 min. vs. 14.9 min. vs. 15.5 min.). The meal and the toilet segments (Tab. 1) play the principal roles to decide the Direct time consumption level, and other segments tend to increase with smaller ratio than that of meal or toilet segment when eating or toilet level is decreasing.

4.3 Mental factor and Resource consumption

In Tab 2-1, the effect of the mental level in the Immobile group is shown. The first line means that 62 cases, whose elderly type was I-3 (eating ability is 5 or 4) and mental level was relatively well maintained (mental level is 5 or 4), consumed average 40.2 minutes of the Direct Service time, and the 286 cases of the relatively mental deterioration counterparts required 44.4 minutes of the Direct Service time. There was not a statistically significant difference (P=0.15) between the two groups and only 0.6% of the Direct time variance could be explained when the I-3 type was separated into 2 groups by the mental level. Although the 47.8 minutes Direct average in the mentally intact group and the average of 59.7 minutes in the mentally deteriorated group showed a statistically significant difference (P=0.01), this difference was explicitly derived from the opposite composition of the elderly types between two groups (higher ratio of I-3 (62/78) in the mentally intact group vs. relatively low proportion of I-3 (286/796) in the mental deterioration group).

The effect of problem behaviors on the resource consumption is displayed in Tab. 2-2. 19.4 minutes consumed by the problem behavior (-) samples in C-4 group didn't show the statistical difference at the 5% significant level against the 17.3 minutes of the Direct time consumed by the problem behavior (+) samples in C-4 group. All types except I-2 didn't show the statistical difference at the 5% significant level. When the statistical difference of the effect of the problem behavior to resource consumption were tested at the 1% significant level, the effect of the behavior problem was not achieved in this study.
4.4. Elderly Type and Functional Level

The average functional level in each elderly types is shown in Fig. 6. Although elderly types were determined based on resource consumption, this categorization has consequently demonstrated the strong relationship between the functional level of elderly people and the resource consumption.

The sharp descent of mental level between the B-3 (mental average : 4.42) and the C-4 (2.06) can be explained by the definition of the major groups. The vast discrepancy of the average mobile level between C-2 (3.27) and I-3 (1.20) is also predictable through the definition. But the continuous mental decline from C-4 (2.06) to C-3 (1.56) and to C1 (0.90), the consecutive mental deterioration from I-3(1.85) to I-2 (1.00) and to I-1 (0.52), and the gradual mobility level decline in both the mobile confused group and the immobile group cannot necessarily be explained by the criteria of the sub-categorization, because these subcategories were defined by using the eating or toilet functions regardless of the mental ability or the mobile ability. These concurrent declines suggest the strong correlation between 'mental or mobile abilities' and 'eating or toilet functions'. In other word, when eating or toilet function level is descending, the deterioration of mental and / or mobile function level are strongly suggested.

The distribution of eating and toilet function of C-3 type, who requires either eating support or the toilet support, is shown in the Tab 3.1. Although the number of patients who required the toilet support but were independent of meal was 191 out of 196 (97.4 %), contrary cases, who needed eating support but independent of toilet were only 6 (2.6 %). This finding suggests that most of mental impaired cases require toilet supports earlier than eating supports.

The distribution of eating and toilet function of all cases is demonstrated in Tab 3.2. Because a patient, whose receiving services was recorded for 48 hours, was counted as 2 resource samples and was regarded as a 1 function sample, the number of resource samples was 2289 and that of function samples was 1260. The number of cases who were independent of both meal and toilet was 387 (30.7%). The number of samples who required both feeding supports and toilet supports were 417 (33.1%). 450 cases (35.7%) were independent of eating but dependent of toilet actions, although only 6 cases (0.5%) were independent of toilet actions but required eating supports. This finding leads the hypothetical functional
deterioration process, that is (Both Meal and Toilet are independent) -> (Meal is independent but Toilet is dependent) -> (Both Meal and Toilet are dependent). The aged people whose toilet function is intact instead of the dependence of meal can be regarded as the exceptional case.

5. Discussion

In the chapter 4.2., the relationship between the elderly type of TAI and the corresponding resource consumption were explained. In the chapter 4.4., the functional deterioration was described with the elderly type. By combining the two results shown above, the hypothetical model for explaining the gradual functional deterioration in the elderly (Fig. 7) could be obtained. This model summarizes the gradual functional deterioration process and the mechanism how functional status effects to the resource level required.

On the two dimensional space composed by the axis of the major elderly types and the axis of the total ADL level deterioration from 5 (independent) to 0 (tube feeding), the gradual functional deterioration process of the aged is described. In the case of the physical decline without a manifest mental impairment, the course of ( B-4 -> B-3 -> I-3 ->I-2) is predicted. In the case of the typical Alzheimer patient, some initial mental abnormalities emerge (C-4) at the first stage, and toilet support is needed after a while because of frequent toilet accidents (C-3). Additional mental deterioration sometimes require a spoon feeding (C-2) before his or her immobility (I-2 or I-1), but most of confused elderly become unable to walk (I-3) prior to the necessity of a spoon feeding and trace (C-3) -> (I-3) -> (I-2) according to author’s experience. The procedures included in M-0 (Obligation feeding such as a nasal pharyngeal tube) are often selected in long term facilities in Japan at the terminal stage of (I-1), when elderly people face a difficulty to swallowing foods and liquids.

Fig. 7 also shows the corresponding approximate resource consumption levels with the deterioration process in Japanese facilities. Approximately 20 minutes excess resource is consumed in Japanese long term facilities when toilet assistance is needed regardless of major categories. Another additional 20 minutes is needed if the status of patients change from eating independent to spoon feeding required, regardless of his or her mobility. When spoon feeding becomes difficult and risky because of
further functional deterioration (I-2 -> I-1), an extra 20 minutes resource is consumed. When toilet or eating status is changing, more than ten minutes out of 20 minutes of additional time is consumed for toilet or eating time, and the other service requirements proportionally increase. It is useful for staff or managers to recognize that 'B-4 and C-4' or 'B-3 and C-3 and I-3' or 'C-2 and I-2' similarly consume resource although their functional types are widely different.

Two substantial exceptions related to Fig. 7 should be addressed. The first one is the recovery cases by means of rehabilitation and some training. Toilet independence achieved by a persevering toilet training (C-3 -> C-4) or self transfer accomplished by successful rehabilitation (I-3 -> B-3 and sometimes I-3 -> B-4) can often be observed. The second exception is the accidental case, including severe acute disease, injuries (especially fractures of bones), and so on. Although patient's status corresponding to accidental cases are classified into M-A (Acute medical case) or M-I (Intensive medical case) in TAI, the status after recovering M-A or M-I is sometimes shifted to other status by jumping over some steps such as B-5 to I-2 after a severe stroke. Accidents are the frequent triggers to proceed the ADL deterioration step, and every elderly type has the probability to be directly connected with every other type through accidents. In order to emphasize the functional deterioration trend without accidents and facilities' interventions, opposite direction arrows indicating functional recoveries and the jumping up process derived from the accidents were omitted in the figure. If this chart is used for reporting a personal functional change, exceptional arrows corresponding to the functional recoveries and accidents should be added.

To legitimize this model, some conditions are required. The first condition is that the Border group (B-5, B-4, B-3), who are mentally intact and can walk, don't require spoon feeding supports. Only 1 case out of 232 Border group needs spoon feeding. The second one is that when the elderly people belong to the Immobile group (I-3, I-2, I-1), they always need toilet supports. Only 6 cases out of 489 immobile samples don't require full toilet supports. The third required condition is that the aged people, who are dependent of eating, are always dependent on toilet actions. Only 6 out of 456 cases who need feeding supports (Eating level <= 3), don't need toilet supports. These 13 (=1+6+6) cases out of 1,260 cases are inconsistent with this functional trends. Although most of C-3 type patients consumed 15 to 60
minutes, some cases of C-3 type needed less than 15 minutes and some were requiring more than 60 minutes. The range of duration of minutes displayed at the right side of the figure covers 80.5% of samples. In other words, 19.5% of samples consume below or above level of resource.

This hypothetical model was constructed with a spot time-study, a spot survey of patients’ characteristics, and the author’s experience as a physician. In order to transform the hypothetical model to an absolute finding, a longitudinal study such as the Normative aging study11, is required for following up functional deterioration processes of many elderly. For proving this hypothetical model and for evaluating the effect of some interventions in some long-term facilities to functional transitions of patients, an additional cohort study is planned in Japan.

Although the design of TAI was referring to the empirical view of staff in units, some empirical issues could not be reflected. The most outstanding discrepancy between the experimental sense and TAI was mental affairs. Freis12 pointed out that ‘Cognitive impairment was associated with slightly higher resource use only in patients without major medical problems and serious functional dependencies. Cognitively impaired patients with severe behavior problems were statistically indistinguishable in resource use from those with only cognitive impairment.’ In this study, the similar result, which indicate little effect of mental problems to resource utilization, could be obtained as shown in the chapter 3.3. According to the interviews to caregivers of the SFC study and author’s experience as a physician, the burden of care to confused cases, especially cases with problem behavior, was much heavier than those of mentally intact cases. There might be two primary reasons for explaining the discrepancy related to these mental factors. The first one was uncountable mental tension when staff members were responsible for mentally deteriorated cases. A lot of mentally deteriorated cases required caregivers continuous attention for preventing them from facing dangerous situation, because they often behave in unpredictable manners. But it is rare for staff to concentrate on only an observation to a specific patient. Because staff were glancing at cognitively impaired cases while performing other tasks, these frequent but instant attentions were recognized as an emotional burden by caregivers, but were not counted as the resource consuming service. The second reason for explaining the discrepancy was the low frequency rate of time consuming behavior problems. During 5,700 hours time study, only two time
consuming behavior problems occurred. The first case was an escape from a facility, and the second one corresponds to a temporarily excited and violent patient. These two cases were very time consuming and obliged some staff members to be stressed and to face to some physical risk. As these accidents temporarily require intensive resource consumption once a problem breaks out, and because these accidental affairs were so impressive as to remaining staffs’ memory for a long time, the burden of corresponding to problem behaviors might be overestimated by care-givers in spite of rare occurrence. These findings display the limitation of time sampling data, and strongly suggest the necessity of the new instruments, with which the burden of care can be quantitatively evaluated.

Some other limitations of TAI are also shown below. Because it is developed based on the resource consumption by nurses and care-givers, the medical service provided by physicians and the rehabilitation performed by therapists were not counted. To calculate the total personnel cost required for providing the service in long term facilities, a physician fee, a therapist fee, and other fees including administration staff, cooks in kitchen, and so on should be separately calculated. As TAI was developed by mainly focusing on the care service, it is unsatisfactory for physicians and medical oriented nurses who are interested in more detailed information related to medical conditions of patients and medical services. If the categorization which includes more detailed medical information is needed, more comprehensive instruments such as MDS is useful. If minute functional records are required, more functionally specific criteria such as FIM should be selected.

Compared with previous measures, one of the advantages of TAI is that it highlights the longitudinal functional change, thereby creating a more dynamic model. This advantage of TAI enables staff working in units to recognize and to predict the longitudinal change in inpatients. Another characteristic of TAI is that it is less time consuming because of the very limited number of questions required. These characteristics of TAI make regular and frequent (e.g.: monthly) data collections effortless. Once data are collected, the data can be put to multipurpose use: (1) long term following of personal functional transition from independent to fully deteriorated, (2) comparison and transitional monitoring of a case-mix in a unit or in a facility, (3) estimation of personal level and unit level resource consumption required for providing care service.
As the social burden for supporting the elderly will expand rapidly, it is necessary that even those who are not familiar with the requirement of care for the elderly understand the aging process and the need for care in order to achieve a consensus on sharing the burden. TAI and the functional deterioration model can provide a bird's eye view of the aging process and the needs for inpatient care. The author hopes that this study can contribute to the mutual understanding between the fragile aged person, staff in units, managers in facilities, social fund distributors, and tax payers.

6. Acknowledgments

The authors gratefully acknowledge the statistical instruction provided by Prof. Frederick Mostella, Harvard School of Public Health and the precious assistance provided by Prof. Shigekoto Kaihara, Computer Center University of Tokyo Hospital, and Dr. John Morris, Hebrew Rehabilitation Center in Boston, and the administrations and the staffs of 11 facilities across Japan and 700 students working for time-sampling study.

7. References


12. Fries BE, Mehr DR, Schneider D, et al. Mental dysfunction and resource use in nursing home. Medical Care 1933; 31: 898
(Appendix A)

- Reliability of Service Data -

Before starting the large scale time study, the author compared a self recorded data and time-keepers’ data with three teams (One team : One caregiver and two time-keepers). A staff working for three hours while performing self-recording was also assigned two timekeepers who recorded the staff's work at the same time. Three items listed below were compared with using the data recorded by three groups. The items compared were (1) the consumed time for the self record, (2) the average duration of minutes recorded by a caregiver (self record) and by assigned time-keepers, and (3) the coincident rates within a team. When time-keeper No. 1 recorded 'meal time 31 min. and toilet time 24 min' and time-keeper No. 2 recorded 'meal time 29 min. and toilet time 26 min.', the coincident rate between two timekeepers was calculated as 96.4 % = (Same contents record : 29 +24) X 2 / (All record : 31+ 24+ 29 + 26).

A care-giver consumed 2 minutes per hour for her self-recording on the average. A care-giver could record 59.2 minutes data per hour by herself on the average, and the average time recorded by time-keepers was 56.0 minutes in the trial. The average coincident rate between two timekeepers was 92.6 %, although the average coincident rate between a timekeeper's record and a self-record was 78.6%. The high coincident rate between timekeepers' data and the relatively low coincident rate between timekeeper's data and self-record data indicated the higher reliability of the timekeeper's data compared with the self-recorded data. The discrepancy between timekeepers' data was caused by the different interpretations of the service for deciding a suitable service category and for deciding the timing of the beginning and the ending of the service. The greater discrepancy between a timekeeper's record and self record was mainly derived from the technical difficulty of self-record. According to the interview of care-givers after the trial, an eye measure with managing to make the account balance was sometimes unavoidable while performing a self-reporting, and the obligational self-report made them out of pace because of frequent interruptions for recording required. As attaching a timekeeper potentially influences the behavior of a care-giver, the data recorded by a time-keeper may have some bias. But because of the higher reliability and little interruption to caregivers during their work, not a self-report but a recording by a timekeeper was adopted as the time sampling method in this study.
Before starting time studies, the seminars for instructing timekeepers how to observe the service and how to record the data were performed. After taking these seminars, every time-keeper attended the data collection. Duration of time was rounded to the nearest minute, that is 29 seconds of duration was counted as 0 minute, although 30 seconds were recorded as one minute. If one care-giver provided services to multiple patients at the same time, the duration of time was distributed according to the burden of the service provided to patients.

With the working schedule, a theoretical recorded ratio can be obtained. If a caregiver worked from 9 a.m. to 5 p.m. (60 X 8=480 min.) and totally 450 min. of service contents were described, the time-keeper could record 93.8 % (= 450 / 480) of her work. According to the calculation based on the working schedule in the facilities, 93.4 % (= 56.0 min. per hour) of working time was theoretically recorded in this study.

(Appendix B)

-How to define the major categories and sub-categories-

For defining the major categories, the mental cut-off level, above which a case is regarded as mentally intact and below which is interpreted as mentally deteriorated, should be chosen. At the same time, the mobile cut-off level, above which cases are thought to be mobile and below which are assigned as immobile, also needed to be defined. Although these cut-off lines could be decided apriori, the one combination of mental and mobile cut-off levels for TAI was selected from a great number of potential possibilities according to the procedure described below. ' TAI Mental (5-4) | (3-0) ' (displayed in a horizontal shaded area at the upper left side in Fig. B-1) represents that the vertical line between (5-4) and (3-0) indicates the mental cut-off line, and the aged inpatient whose TAI mental level is 5 (sufficient mental level for normal life) or 4 (satisfying both (all exact answers to three orientation questions) and (no behavior problems within two weeks)) is regarded as mentally intact, and the aged persons are judged as mentally deteriorated when their TAI mental level is 3 ( (all exact answers to three orientation questions) and (recent behavior problems observed)) or less. ' TAI Mobile (5-3) | (2-0) ' displayed in a vertical shaded area indicates that the aged inpatient whose TAI mobile level is 3 (who can manages to walk or
move by him/herself) or more is regarded as mobile, and the aged person, when his or her TAI mobility level is 2 (who can not walk but can sit up on a bed by him/herself) or less, is thought to be immobile.

With the mental and mobile cutoffs, the sample classification (shown at the lower right in Fig. B-1) could be composed. As explained in chapter 3.3., because the group, who were mentally intact but immobile, has an insufficient number of samples for making a major category, and because there wasn't the statistical significant difference of the Direct time consumption between mentally intact immobile people and the mentally deteriorated immobile inpatients, one immobile group was constructed by combining mentally deteriorated immobile patients and mentally intact immobile ones. When the samples were divided into these three groups (Border, Mobile Confuse, Immobile), 31.7% of the power of explanatory variance (r2) could be obtained with the analysis of variance with formula as shown below.

\[
(n= \text{number of Total sample, } i = \text{one of border group, } j = \text{one of mobile confused, } k = \text{one of immobile})
\]

In this study, outlier samples (Medical case) were eliminated at the first. Next (as shown in Fig B-1), 12 kinds of mental cut-off applicants (selected from FIM, MDS, and TAI) and 15 kinds of mobility cut-off applicants (selected also from FIM, MDS, and TAI) were prepared, and 180 (=12 X 15) kinds of the combinations of the mental and mobility cutoff applicants were assembled by permutations and combinations, such as a couple of (FIM memory (7-6) | (5-0), TAI mobility (5-4) | (3-0)) and so on. Thirdly, every power of the explanatory variance (r2) of the Direct time consumption was calculated using the analysis of variance, and every power of explanatory variance was compared as displayed in the table (Fig b-1). Finally, the combination of (TAI mental measure (5-4) | (3-0), TAI mobility measure (5-3) | (2-0)) was selected as the final cutoff combination for defining the major categories, because the power of the explanatory variance of the combination (31.7%) was the highest.

The mobile confused group was classified into three resource consumption levels (Fig. B-2). For dividing a major group into three sub-groups according to the resource consumption levels, two kinds of cutoff including the low-medium cutoff and the medium-high cutoff should be concluded. 20 kinds of potential candidates for the low-medium resource consumption cut-off were selected in the shape of a
single or couple (combined with ‘&’ or ‘or’) conditions, as shown in the first horizontal line in the table, after testing the power of the explanatory variance of 43 kinds of single cutoff applicants including eating, toilet, dressing, grooming, mental, problem behavior, transfer and locomotion in FIM, MDS and TAI. With the similar procedure shown above, 20 kinds of the medium-high cut-off applicants were selected as shown in the first vertical line in the table. By using both Low-Medium and medium-High cutoff applicants, major group was classified into three groups (illustrated at the low right corner in Fig B-2). 400 (20 X 20) kinds of explanatory variance shown in the table were calculated and the combination whose explanatory ability was the highest were selected as the final cut-off for classifying the mobile confused group into three types. The cut-off points for dividing the immobile group were decided with the same procedure. When defining the low-medium cutoff for the border group, the exceptionally multifold condition (Mental=5, Mobility=5, Eating=5, Toilet=5), which was almost equivalent to independent, was prepared in behalf of the specific identification of the independent type of patient. 20 kinds of the low-medium cutoff applicant including the independent patient case and 20 kinds of the medium-high cutoff applicants for the border group were prepared and the final cutoff points were also decided after calculating 400 kinds of the explanatory abilities. The medical group was exceptionally classified with the definition shown in the Fig. 4.

(Appendix C)

-Predictive Validity of TAI-

In order to test the predictive validity of TAI, every sample were allotted a sequential number from 1 to 2289 with a random number table, and divided into an odd or an even group (Tab. C). With odd and even group samples, the average Direct consumption time of every elderly type were calculated and the results were compared. With TAI categorization, 64.0% of the Direct time variance of the odd group could be explained and 62.3% of the Direct time variance of the even group could be obtained. As the difference of the average of Direct time consumption between the odd group and the even group was tested, the p value was 0.9057 and there was not statistical difference between two groups.