income level register for the LTCI system contains the register code and a classification code of the household income level of the current users of LTCI services, based on household members' taxation and taxable pension income of the elderly to estimate an LTCI premium amount. These two registers were linked using the register code as the key linkage. The combined dataset thus comprised basic demographic characteristics and the long-term care history of all individuals who received benefits from the LTCI system in City A.

The total expenditure for each subject in the study population was calculated as the sum of the total monthly expenditures claimed by providers during the study period. The data on the total expenditures of the sample was sorted by values, ordered from largest to smallest. Then, using a quartile function, we identified the top 25% of individual total expenditures group in the sample population. The cut-off (Q3) to choose the target group was ¥ 3,029,500 and participants in the top 25% of the total expenditures group were considered as the high expenditure subgroup. This target subgroup represented 45% of the total annual expenditures of the study population. For each individual in the sample, a monthly URB was calculated as the proportion of insurance benefits units used by a recipient over the fixed limits of benefits defined by each certified CNL in the Japanese LTCI system.

Conceptual model

From a theoretical point of view, and following the simple approach proposed by Norton, we assume LTCI expenditures for an individual as a function of a number of factors, including socio-demographic characteristics (age, gender, education, marital status, family structure), economic circumstances (income, insurance coverage), disability status (based on standard assessments of dependency and care needs), and geographic factors (provider supply and regional services utilization patterns). Rather than estimate a fully specified model, we used a simplified model that focused on the effects of the utilization rate of insurance benefits, disability status and institutional care services used, while controlling for a limited number of relevant factors.

Dependent variable

As with health care expenditures, long-term care expenditures have a skewed, rather than a normal, distribution and a log transformation can be used for the OLS estimation (Manning & Mullahy). However, we were not interested in predicting log expenditures; rather, our interest was to identify which factor(s) predict membership in the high expenditure group in City A. A dichotomous variable indicating membership in the high expenditure group was defined for each participant as the outcome variable (Y = 1). Analysis of this dependent variable was then conducted from the perspective of the LTC insurer.

Independent variables

Research on LTCI expenditures does not offer a specific conceptual framework at the individual level to guide the selection of independent variables, nor does it suggest how the variables may interact to influence LTCI expenditures. On the other hand, despite that have been desirable to include information about the effect of the change in Japan`s family structure in favor of nuclear family or the increase in female labor force participation rate in our model, unfortunately data about this factors is not available. Data about informal care is not captured at insurer level in Japanese system because, universal benefits entitlement for the elderly are based strictly on the extent of physical or mental disability, regardless of economical conditions or whether potential informal caregiver network are available. However, based on empirical evidence available in the literature, we assumed that an individual's probability of incurring high LTCI expenditures was affected by age, individual disability status, income level, insurance coverage, and consumption pattern of services, as the main expenditure drivers.

There is evidence that LTCI expenditures depend on the age of the elderly. Age was included as a categorical variable with four levels: less than or equal to 74 years (reference group), 75-84 years, 85-94 years, and equal to or greater than 95 years.

A univariate analysis was carried out and gender and income variables were not significant, but were forced to remain in the model for adjustment. Gender was a dichotomous covariate, where female was chosen as a target group. The household income levels for the LTCI system in City A were classified in six levels, from lowest to highest. We designed a categorical variable with three levels, aggregating the two lower, the two middles, and the two highest levels. The lower category was included in the model as a reference group.

A relative change in URB was calculated for each subject in the study as a measure of the change in insurance coverage during the study period. It was calculated as the proportion of the difference between URB at the end of the study period and the URB at the baseline time over the URB at the baseline time. A dichotomous covariate was designed; an increase in the relative URB was our variable of interest; otherwise, no change or a decrease in the relative utilization rate was set as the reference group.

The disability status of the participants, one of the main areas of focus in our study, was included, with two dimensions being considered: a static dimension, represented by the Care Needs Level at the end of study period, and a dynamic dimension, capturing the change in the disability status during the study period. The Care Needs Level contains seven categories: two support levels - Support Level 1 and 2, and five care categories - from Care Level 1 to 5, lowest to highest, respectively. Additionally, the Care Needs Level was included as a categorical variable with three categories: a lowest category including both support levels and Care Level 1, a mid level category formed by Care Level 2 and 3 and finally, a highest category, including Care Level 4 and 5. The

lowest category was chosen as the reference group.

Change in disability status was calculated by subtracting the baseline Care Needs Level from the Care Needs Level at the end of the study period. If a participant change in Care Needs Level was calculated to be greater than zero or equal to zero when the subject remained at Care Level 5 throughout all study periods, this was defined as a decline in dependency level was defined and coded as decline in functional status. Otherwise, participants whose change in Care Needs Level was equal to or less than zero at all needs levels other than Level 5 were defined as unchanged or improve of the disability status and coded as unchanged functional status. A dichotomous covariate having a decline in functional status as the variable of interest was designed.

A breakdown by type of services of the total LTCI expenditures in Japan for FY2006 shows a significant proportion spent on facility services (45%), followed by home-based services (36.5%) and commuting services (18.5%). The per-capita average expenditures by type of facility services in April, 2006 was ¥253,000 in a special nursing home, ¥262,000 in geriatric intermediate care, and ¥373,000 in health care facilities for older adults [20]. In our data, at the end of the study period, the main consumption patterns of services included facility services (32%), commuting services (26%), in-home services (8%), and mixed services (i.e., more than one of the categories mentioned previously, excluding facilities) (30%). Because evidence cited earlier showed that monthly average expenditures by the elderly for facility services (institutional care) grew steadily in Japan, we focused on this aspect. A dichotomous covariate was designed and facility services utilization was chosen as the variable of interest. Utilization of any other LTCI service was considered as the reference group.

Statistical analysis

A descriptive analysis was undertaken to understand the relationship between the high expenditures group and the covariates set. The chi-squared test was used to analyze the relationship between the outcome variable and covariates set.

A binary logistic regression model was used to examine the effect of the covariates on total expenditures in the high expenditures group. The modeling proceeded in three stages. First, variables the chi-squared test for which had a p-value < 0.25 (Hosmer-Lemeshow) in a univariate analysis were selected to be included in a preliminary model. Second, including all set of covariates to identify variables which make contribution to the model in presence of other variables we build a main effect model. A stepwise procedure was useful to identify the relative importance of the covariates set in the model. The inclusion and exclusion criteria for the stepwise regression were both 15% (Hosmer-Lemeshow). The Wald statistic test for each covariate was examined, and those with a significant level $p < .05$ were included in the final model. These variables were: a) age, b) increase in relative URB, c) decline in functional status, d) Care Needs Level, and e) utilization of

facility services. Gender and income were not statistical significant but forced to stay in the model to controlling for their effects. Finally, the interaction among some explanatory variables was examined. A second-order interaction between facility services utilization and the highest care needs level category was significant and included in the final model.

Multicollinearity was examined via a correlation matrix and multicollinearity diagnostic statistics, from a regression of the covariates set on an "exogenous" variable i.e., a log-transformation of total expenditures. A logistic regression diagnostic was carried out to identify influence or outlier covariate patterns (Hosmer-Lemeshow). Plots of the change in Pearson χ^2 and Deviance χ^2 against predictive probability was used to detect outliers or influential points. One case was identified and excluded from the analysis, improving the overall goodness-of-fit of the final model. Hosmer-Lemeshow and -2 log likelihood tests were used to check goodness-of-fit of the final model.

The results are reported as odds ratios and differences in predicted probabilities of high expenditures, conditional on the vector of predictor variables. For each dichotomous or categorical variable, the odds ratio indicated the ratio of the odds of belonging to the higher expenditures group for the given category, relative to the reference group, while controlling for other covariates. The method of logit differences was used to estimate the odds ratio for the interaction term; the confidence intervals for the odds ratio were calculated using standard error methods (Hosmer-Lemeshow).

To estimate the overall change a given covariate had on the outcome variable in terms of the differences in the predicted probabilities between target and reference group, we use the delta-p statistic, according to the method suggested by Cruce. The delta-p statistic is a measure of a discrete change in the estimated probability of the occurrence of an outcome, given a one-unit change in the independent variable of interest, with all other variables held constant at their mean values. Delta-p is calculated as the difference in the probability of the occurrence of an outcome between a target and reference group (Cruce). However, following recommendations by St. John (1991) [45] the use of the delta-p statistic was limited only to those covariates found to be significant in the model, because there is no known procedure to estimate the statistical significance of delta-p (Cabrera). All analyses were conducted using the SAS software, version 9.1 for Windows(SAS Institute Inc.).

3) Study 3:

Data & participants

Participants were selected from the dataset of the LTC insurer of City A, located in a suburban area approximately 100 km west of Tokyo. The estimated population as of October 1, 2006, was 52,343, and the proportion of elderly persons was 20.8%, the same as the average in Japan. The database contained basic demographic characteristics and information on the utilization of insurance

benefits and services, which is periodically collected by the insurer from LTC providers. Consent for use of the dataset was granted by the municipal government of City A after a formal application, along with an explicit pledge to protect the confidentiality of the data supplied. Ethical considerations were examined in accordance with Japanese epidemiological guidelines for secondary data analysis. Ethics approval was obtained from the Ethics Committee of the University of Tsukuba, Japan.

Participants in the study were selected based on the following criteria: (a) elderly persons i.e., aged 65 years or over; (b) newly certified as being eligible for CL1 benefits; (c) have used LTC services consecutively at least 6 or more months; and (d) have remained at least 3 months consecutively in CL1. We selected 6 months as a minimum stay in the LTCI system and 3 months in the CL1 to assure model stability. Participants who used facility services during the observation period were excluded (n = 20). We started enrolling participants in July 2001 and continued for 57 months until March 2006, with an additional 15 months of follow-up until June 2007. The final data set contained records for 369 participants. This cohort was followed during their stay in the LTCI system to determine individual disability transition status every 6 months during the first 2 years and annually thereafter.

Measurements

Dependent Variable

The outcome variable for the analysis was the length of stay at CL1, defined as the total number of months at CL1, was calculated from the time when participants became LTC service users until a change in care-needs level category or censure. A participant who changed from the certified baseline CL1 was considered an event. Participants who dropped out of the LTCI system (n = 34), those were away from the system for more than 1 month (n = 57) or who remained at CL1 without having experienced an event during the observation period (n = 21) were treated as a censored observations.

Independent Variables

Three dimensions of the LTC services utilized, including type of service, number of different types of services, and services delivered (days/month) were examined as potential predictors for length of stay at CL1. Age, gender, income level, length of stay in the LTCI system, and utilization rate of insurance benefits were included in the overall model as potential confounders. To evaluate types of service, we categorized services into three groups, in-home services, commuting services, and a mix of both, based on the median number of kinds of services used during the observation period. In-home services included home-help, bathing service, nursing visits, rental services for assistive devices and guidance conducted by doctors or other personnel. Commuting services

included day care, outpatient rehabilitation and short stays for care/assistance in daily activities. If both in-home and commuting services were used, we considered this a mixed service. Dummy variables for each type of service were created, and mixed services were considered the reference.

The number of kinds of services was determined by the median number of services utilized during the survival time and was included in the model as a dichotomous variable; the use of two or more services was the group of interest, and the use of only "one service" was considered the reference. The amount of services delivered was calculated as the total days on which services were utilized during the survival time divided by the number of months of survival to create a continuous time-dependent variable.

Age indicates age in years at enrollment in the study. Gender was a dichotomous variable, and female was chosen as the variable of interest. Insurer of City A classify insured income level, in 6 categories from level 1(the low) to level 6(the high) according to taxation level of household members and/or elderly beneficiaries. Income level was included as a continuous variable. Length of stay in the LTCI system was included as a continuous variable to assess participant continuity in the LTCI system. Additionally, we calculated the utilization rate for insurance benefits (URB), i.e., the monthly proportion of insurance benefit units effectively used by a recipient divided by the fixed limits of benefits for CL1 in the LTCI system. The limit of benefits at CL1 was 16,580 units/month. URB was calculated for the overall time until the event of interest or until censoring occurred, and it was included in the model as a continuous variable. To compare survival curves and evaluate the effect of in-home and community-based services on length-of-stay in CL1 among disability transition strata, we included a categorical variable containing disability transition status as "improved" or "declined" at the event time. Subjects who showed no change from the former CL1 during all observation periods were considered the reference group.

Statistical analysis

We used Cox proportional-hazard regression analysis to model the effect of each covariate affecting the length of stay at CL1. The length of stay at CL1 (months) corresponded to "survival time" to assure a reasonable time to observe the occurrence of an event. The end of the observation period was set at 36 months after participants became LTC users. Subjects whose survival time exceeded 36 months were considered censored at 36 months (n = 37). However, because people in the lowest eligibility level are generally re-evaluated every 6 months by the insurer, we conducted a separate analysis every 6 months during the first 2 years of the observation period. The Kaplan–Meier method was used to obtain crude survival estimates, and survivor functions were plotted to compare disability transition strata.

As a first step in the Cox regression analysis, a univariate analysis of each predictor affecting the overall length of stay at CL1 by each phase of the observation period was investigated. The

effect of transition disability status was also examined in the univariate analysis. Second, the effect of the covariates with potential confounders controlled was tested in each phase of the observation period through a single multivariate Cox regression analysis. Finally, separate hazard models were conducted to examine length of stay at CL1 across phases of the observation period for both the "improved" and "declined" disability transition strata. Age, gender and income level were entered as covariates in both strata analyses. Given the moderate sample size of these strata, a likelihood-ratio statistics was used to test the null hypothesis that all the coefficients associated with the covariates were zero.

Multicollinearity was examined via a correlation matrix and multicollinearity diagnostic statistics. A residual analysis to detect outliers and influential data was performed using deviance residual plots. Values of the deviance residual >2.5 were considered outliers and were excluded from the final analysis. The proportional-hazards assumptions were tested by including covariates by log-time interactions in the models. Goodness of fit of the models was evaluated as a function of the log-likelihood of the model with all parameter estimates and the log-likelihood of the model without the set of covariates. Data were analyzed with SAS software version 9.1 for Windows (SAS Institute, Inc., Cary, NC, USA).

C. Results

1) Study1:

Characteristics of the Baseline Group

Table 1 summarizes the basic characteristics of the 327 subjects of the study cohort by March 2006. The average age was 83.1 years, ranging from 67–101years. There were 240 female subjects (73%). The aged group over 80 y-old represented 69.7% of the sample. Thirty-one percent of subjects of the baseline group were certified in Support Level and 69% in Care level 1 in March 2006.

The overall average utilization rate of benefits of the study cohort was 59.3%. The main services used by Support Level recipients were: commuting services(54%), in-home services(44%) and short-stay services(2%).On the other hand, Care Level 1 recipients utilized commuting services(47%), in-home services(34%),short-stay services(10%) and services at facilities(9%). It must be pointed out that recipients can use more than one service; 24% and 41% in Support Level and Care Level 1, respectively.

Services Utilization: Care-Mix of services

In city A, with exception of the utilization of facilities services all the LTC services are accounted in a daily-based system, i.e. services are provided and counted in days-used monthly. According the

categories of services after the revision, the services in "new prevention benefits" were gathered into; services to prevent the need for care, support to prevent the need for care and community-based prevention programs. Services to prevent the need for care includes: home-visit services, commuting services and short-stay services [4].

We compared the care-mix of services between equivalent categories of the baseline group with the cohort at the end of the study period. The proportion of the total days used by services to prevent the need for care in each category was calculated. On the figure 2 the proportion of the total days used by services to prevent the need for care by subjects in Support Level pre-2006 revision and recipients of "Support Level 1" and "Support Level 2" of the new classification, are compared.

Three services explained the 95% of the total days (n:1,142 days) consumed by subjects belonging to Support Level before the LTCI revision; "leasing of welfare appliances" (40%), "day services" (30%) and "home help services" (25%). However, at the end of study period in "Support Level 1"; "day services" (50%) and "home help services" (34%) consumed most of the days (n: 262 days) of this group. At the same time, recipients of "Support Level 2" consumed a total of 663 days distributed in: "day services"(44%), "leasing of welfare appliances" (28%), and "home help services" (17%). The difference of the patterns of care-mix of services between Support Level pre-revision and both of the "new support" categories, were statistically significant (X^2 *test,* $p = .000$).

On the other hand, figure 2 exhibits the proportion of the total days used by services to prevent the need for care in subjects in Care Level 1 before and after the revision. Before the revision, three services explain 87% of the total days consumed (n: 3,963 days) in this care level; "leasing of welfare appliances" (45%), "day services" (27%) and "home help services" (15%). However, a year after the law amendment implementation, "day services" (54%) and "home help services" (17%) consumed most of the total days (n: 853 days) of the Care Level 1. The difference between patterns of care-mix of services within this care level was statistically significant (X^2 *test,* $p = .000$).

Utilization rate of Benefits

The average utilization rate of benefits of the baseline group was 58.2% in subjects with Support Level and 59.8% in Care Level 1 as of March 2006. There was not a significant difference in the means for the utilization rate of benefits between these categories at this time.

Once the recertification process was carried out and compared the mean of utilization rate of benefits of the baseline group at Support Level with subjects in the new Assistance categories; "Support Level 1" and "Support Level 2", a decrease of the utilization rate at the end of study period was proved in both new categories. These differences were statistically significant (*Student's t-test,* $p = .0035$ *for SL vs SL1 and* $p = .0005$ *for SL vs SL2*).

An opposite effect was observed in subjects belonging to Care category. In comparison with Care Level 1 of the baseline group, an increase of utilization rate of benefits in subjects of care level

categories at the end of the study period was observed. However, these differences were not statistically significant.

Expenditures, Copayments and Subsidies

Before the LTC law amendment, city A expended a total of ¥ 2.120 billion for LTC services during the period from April 2005 to March 2006. Elderly recipients represent 97% of these expenditures. In this period, the study cohort expended a total of ¥ 294,811,939; it is means, a 14.5% of the total expenditures of elderly recipients on LTC system in city A. The total annual average of expenditures and copayments by person/year of the study cohort during the period of April 2005 to March 2006 reached ¥ 901,566 and ¥ 86,075 respectively. Copayment represents 10% of the total expenditures in most of the cases.

One year after the implementation of LTC law amendment, the total expenditures in LTCI system in City A reached a total of ¥ 2.121 billion. During the period of April 2006 to March 2007, a total annual average of the expenditures and copayments of the study cohort decreased to ¥ 888,404 person/year and ¥ 85,586 person/year, respectively. There was no significant difference in the total annual average expenditures and copayments before and after the law amendment.

A comparison of the monthly average expenditure by care level and gender of the study cohort before and after the law amendment application was conducted. There were not significant differences on average expenditures between genders within care level at the extreme dates of the study. However, when the individual monthly average expenditure of the study cohort was compared, before and after the recertification process, subjects of both gender in the assistance category moved to the "new support" categories, showed a significant decrease on average expenditure (see table 5). On the other hand, women on baseline group belonged to Support Level and who were recertified as Care Level 1 exhibited a significant (*Wilcoxon-test, p-value=.000*) increase of the monthly average expenditures during the study period.

Moreover, table 5 shows the subjects of the baseline group in both gender at Care Level 1 and recertified as Support Level 1 showing a significant decrease of the individual average expenditures. In subjects moved to Support Level 2 only women showed a significant decrease on the individual average expenditures. Finally, men that remained in Care Level 1 during all the study period exhibited a significant decrease of the average expenditures. At this care level, the difference on average expenditures showed by women was not statistically significant.

We compared also, the effect of the law amendment in the total individual expenditure in a subset of the study cohort whom stayed in LTC system from April 2005 to March 2007 (n: 250 cases). Because there is an important dispersion of the total annual expenditure of the subjects in this subset, we used the median to compare this effect. The median of the expenditure one year before the implementation of the law was ¥ 796,110 (min: ¥ 46,000; max: ¥ 3,365,330). One year after the law

amendment, the median of the expenditures reached ¥ 763,810 (min: ¥ 30,000; max: ¥ 3,312,650).

Graph 1 shows the total individual expenditures and the trend curves –exponential- of this subset of the study cohort, during a year before and after the law amendment. Subjects, whose total expenditures were under the median before the revision, increased significantly (Wilcoxon-*test, p= .035)* their total annual expenditures after the law amendment implementation. Conversely, in subjects whose total expenditures were over the median of the expenditures before the law amendment implementation, a significant (Wilcoxon-*test, p= .001*) decrease of the total annual expenditures by person after the revision was observed.

In this cohort, the subsidies are benefits that only compensate women in the former care level and it consists in the exemption of copayments. In the study cohort, subsidies supported 8 persons with an annual average by person of ¥ 83,407 the year before the law amendment. One year after the law implementation, the same beneficiaries were subsidized with an average of ¥ 72,219 by person/year. There was no significant difference in the amount of subsidies in this subgroup.

2) Study 2

Descriptive analysis

The characteristics of the sample population are summarized in Table 2. The sample comprised 862 individuals with a mean age of 83 years (standard deviation, SD = 7.7) and 73% were females. Most of the subjects (74%) belonged to the mid-income level, 14% were in the low level and 12% in the high income level.

Thirteen percent of subjects showed an increase in the relative URB during the study period. A decline in functional status was observed in 36% of the sample at the end of the study period. The care needs level distribution in the sample was; 33% at low care needs level, 38% at mid care needs level and 29% at high care needs level. The breakdown of subjects using facility services at the end of study period was as follows: 32% of the total number of subjects reside in facility services; 54.7% of these facility users belonged to the high care needs level; and 61% of subjects certified at high care needs level used facilities services at the end of study period.

The high expenditures group comprised 216 subjects with a mean age of 85 years (SD = 7.8). Most were females (77%) and the annual average expenditure was ¥ 3.4 million per person (min. = 3.0 million, max. = 5.0 million). The higher expenditures group represents the 45% of the total annual expenditures of the study population.

Model goodness of fit Statistics

The final model on the highest LTC expenditures in City A, it was expressed as follows:

$$\textit{Logit (HIGHEXPij)} = \beta 0 + \beta 1 GENDERij + \beta 2 AGEdummiesij + \beta 3 INCOMEdummiesij + \beta 4 URATEij + \beta 5 FUNCTij + \beta 6 CARELEVdummiesij + \beta 7\ TYPESSij + \beta 8(FACILITYSSij \times HIGHCARELEVij) + \beta 9(FACILITYSSij \times MIDDLECARELEVij)$$

Overall, goodness-of-fit suggested that the model was significant and adequate. The test for overall fit of the model indicated that the model with selected covariates (-2 log L = 364.831) was superior to the model with interceptor only (-2 log L = 967.791). The Hosmer-Lemeshow test result was 0.441, indicating that the model predicts the data well. Estimates of pseudo R^2 in our model shows a Cox & Nell R^2 = 0.505 and a Nagelkerke R^2 =0.747 states that the model manages to explain over 50% of the variance of the dependent variable and indicated an acceptable model fit. The overall logistic regression model was highly significant at the 5% level, as indicated by the likelihood ratio. Wald and Score tests ($p < 0.001$) of the global null hypothesis suggests that a specific coefficient of the covariates equals zero, then at least one coefficient *(β)* in the model is non-zero.

Multicollinearity was examined using a correlation matrix and diagnostic statistics. A moderate expected association between some categorical variables (age and income) was observed. The Variance Inflation Factor (VIF) for each variable was also examined. Values of VIF ranged from 1.06 to 2.36, indicating the non-existence of multicollinearity in the model.

Values for indices of rank correlation indicated that the predictive ability of the model was adequate; 96% of the pairs were concordant. Values of Sommer's D, Gamma and C statistics were sufficient (> 0.92). A large percent estimated area (96.2%) under the receiver operating characteristic (ROC) curve indicated adequate fit of the model. For the probability of event =0.52 the sensitivity (79%) and specificity (95%) of the model were sufficient.

Logit results

Estimates for the parameters obtained through the maximum likelihood estimation method with 95% Wald's confidence limits for the final model are shown in Table 3. The logit results indicated that after controlling for gender and income levels, covariates such as age, increased URB and decline in functional status significantly affected the probability of high expenditures in the LTCI system in City A. However, an interaction between use of facility services and high care needs level was significant, providing evidence for the combined effect of the two covariates. The adjusted OR and delta-p statistics for the final model of high expenditures in City A are shown in Table 4. Controlling for other variables in the model, it was found that to belong to mid or high care needs level were strongest predictors in our model. The odds of being in the high LTC expenditures group

are about 24 times greater for subjects in a mid care needs level as they are for the lowest care needs level. The effect of higher care needs level was involved in an interaction term with facility services utilization in our model. Our analysis also showed that an increase in relative URB was a strong predictor of high LTC expenditure. The odds of being in the high LTC expenditures group when URB increase was 23.5 times higher than those whose URB remain unchanged or decreased during the study period.

Moreover in Table 4, we can see a moderate impact of age and decline in functional status on high LTC expenditures. Controlling for other variables in the model, the odds of being in the high LTC expenditures group when subjects belonged to the 75–84 year age group were about 5.2 times higher than people aged 74 years or younger. Similarly, the odds of being in the high LTC expenditures group for subjects aged 85-94 years and over 95 years were 3.8 and 4.7 times higher than people aged 74 years or younger, respectively. Those classified in a decline in functional status had predicted odds of high LTC expenditures 2-fold higher than persons considered to be unchanged functional status.

Regarding the interaction term between facility services utilization conditioned by higher care needs level, as the coefficients of the two variables move in the same direction we estimated that for subjects using facility services, compared with those using other LTC services, when they are certified in the higher care needs level there is a 3-fold effect on high expenditures. On the other hand, when subjects that use facility services compared with those use another LTC services and they are certified in middle care needs level, the effect on high expenditures was 1.5 times higher, but this difference was not statistically significant (data no shown).

Also, we presents the result of the logistic regression model in terms of calculated delta-p statistics for significant covariates, according the method suggested by Cruce[44] because, interpreting a difference in predicted probabilities requires no specialized knowledge or advanced statistical skills. Subjects that exhibited an increase in relative URB had an estimated probability of belonging to the high expenditure group that is 57.5% higher than for those having an unchanged or decreased relative URB. Those, in the mid care needs level had an increased probability of belonging to the high expenditure group by 42.6% over those in the low care needs level.

A slight difference in the predicted probability of belonging to the high expenditures group was observed for age categories and decline in functional status. The estimated probabilities for being in the high expenditures group for subjects aged 75–84 years, 85–94 years and > 95 years were 21.1%, 15.1%, and 19.3% higher, respectively, than the probability for subjects in the reference group (aged < 74 years). Participants categorized with a decline in functional status had an estimated probability of being in the high expenditure group of only 13.7% higher than for those who had an unchanged functional status. This small difference could be explained by an insignificant difference between the patterns of services used by individuals in both categories. The effect of facility services utilization

conditional on the high care needs level, postulated in our model in terms of the difference in predicted probabilities of belonging to the high expenditures group was 65.4% higher than for those subjects who used other services and did not belong to the high care needs level. On the other hand, the difference in the estimated probability to belong to high expenditures group between who are residents on facilities and users of other LTC services was 33% when subjects are ranked as high care needs level.

In this model we postulate a specific hypothesis that involves the effect of an interaction term between facility services utilization and care needs level. Thus, in terms of the difference in predicted probabilities to belong at high expenditures group, the subjects on the high care need levels have been a probability 65.7% higher than the probability for those subjects use another LTC services and they not belong to high care needs level. On the other hand, the difference in the estimated probability to belong to high expenditures group between facility services users and other LTC services users is 35.2% when subjects belong to high care needs level. Given the non-linearity of the logit model, the interpretation of the coefficient of a interaction term lacks an intuitive interpretation. This conditional effect in a logit model is directly assessed through the "main effect" and its "interactive effect," given by the interaction coefficient. In our model this effect is equal to the difference in predicted probabilities when the high care needs level variable increases from zero to one at different observed values of the facility services utilization covariate. This effect corresponds to the delta-p for the interaction term, which was 0.321 in the model. One interpretation is that the difference in the effect of care needs level by type of services on the estimated probability of belong to high expenditures group is 32%.

3) Study3:

Descriptive analysis

Before the 2005 LTCI reform in Japan, people certified for CL1 benefits represented over 30% of those certified in the LTCI system [28]. In City A, subjects newly certified at CL1 (n = 529) represented 36% of all newcomers into the LTCI system during the accrual period of the study. Of these, 369 met the inclusion criteria of the study, accounting for 69.8% of all CL1 newcomers.

The mean age of participants was 81 years old, and females represented 69% of the participants. Fifty-six percent of the participants were at income level 4, i.e., some household member is subject to taxation, but pension recipient is tax-free. A decline or an improvement in functional status, was observed in 43% and 27% of the sample, respectively. Thirty percent of the cohort remained at CL1 throughout the study period. Forty-nine percent of participants used commuting services an average of 8.5 days/month. In-home services were used by 27% of the participants at an average rate of 20.7 days/months. In total, 63% of the subjects used only one service. The mean URB in the cohort was 0.399. The median length of stay in the LTCI system was 34 months and the median length of stay at

CL1 was 14 months.

Survival analysis

After 6 months, subjects whose functional status improved had a significantly longer stay at CL1 than did participants whose functional status declined. Kaplan–Meier estimates for the overall data showed that the estimated probability of a subject's remaining at CL1 for 6 months or more was 72%, the probability of remaining for 12 months or more was 59%, that for 18 months or more was 43%, that for 2 years or more was 38%, and that for 3 years or more was 24%. The median duration of stay at CL1 was 18 months for censored cases and 9 months for uncensored cases.

Cox proportional-hazards models

In the univariate analysis, none of the potential predictors was statistically significant across phases of the observation period. However, the long-rank test of equality for disability transition strata was highly significant. Hazard ratios for the "improved" disability transition strata showed a tendency to decline across phases of the observation period. Conversely, a trend toward an increase in the relative risk across phases of the observation period was observed for the "declined" transition.

Moderate and expected associations between the use of two or more services and commuting services (0.59) and the use of two or more services and in-home services (0.57) were observed in the correlation matrix. The variance inflation factor (VIF) values for the covariates ranged from 1.02 to 2.18, indicating no multicollinearity. The residual analysis of the Cox regression model for disability strata detected two observations (one in each stratum analysis) that affected model fit; thus, they were considered outliers and removed from the final analysis. The tests of all time-dependent variables were not significant individually or collectively in both the "declined" disability strata ($p = 0.42$) and the "improved" disability strata ($p= 0.75$), so the assumption of model proportionality was fulfilled.

After controlling for potential confounders across all phases of the observation period, an overall multivariate Cox regression analysis showed that only the amount of services delivered at 36 months had a significant effect on the probability of a change from CL1. Thus, for each 1 day increase in the amount of monthly services utilized, the probability of change from CL1 dropped by an estimated 1.6% (data not shown).

"Improved" disability transition stratum

In this stratum, the estimated probabilities that a subject would stay at CL1 for 6 months or more was 62%, the probability that the subject would stay for 1 year or more was 49%, for 18 months or more was 28%, for 2 years or more was 24%, and at 35 months, the longest time to censoring was

11%. The median length of stay at CL1 was 12 months (95% confidence interval [CI], 7–18 months).

The results of the Cox regression model in this stratum, women had a significantly greater probability of improving their functional status during all phases of the observation period than did men, but the rate of improvement decreased across time. Age and income level were not significant during all phases of the observation period. After controlling for other variables, the use of two or more services was marginally associated (p-value < 0.10) with a decrease (from 72% to 60%) in the probability of improving one's functional status after 12 months of stay in the system. Taking the reciprocal, users of only "one service" had a 3.6 times greater chance of improving their functional status than did users of two or more services at 12 months into the observation period. Moreover, a marginal effect (p = 0.09) at 12 months was observed for the amount of services delivered. Thus, for each 1-day increase in the amount of services used, the possibility of improving one's functional status increased by an estimated 3%.

"Declined" disability transition stratum

In this stratum, Kaplan–Meier estimates showed that the estimated probabilities that a subject would stay at CL1 for 6 months or more was 65%, the probability of staying for 1 year or more was 43%, for 18 months or more was 24%, for 2 years or more was 18%, and for 35 months, the longest time to censoring, it was 7%. The median duration of stay at CL1 for those in the "declined" stratum was 10 months (95% CI, 7–13 months).

The results of the Cox regression model in this stratum, despite the adequacy of the models across all the observation phases, and with an exceptionally marginal effect (p-value around 0.10) for the amount of services at 18-months and after, none of the remaining covariates was significantly associated with the hazard ratio for a decline in functional status. As the hazard ratio was 0.98 for the amount of LTC services, this means that for each day of added services used, the probability of decline in functional status decreased by an estimated 2%.

D. Discussion

1) Study1:

With the Law Amendment of LTCI of 2005, the reduction of economic incentives for institutionalization, moving out of the insurance benefits, fees for meals and residence expenses has led to a cost reduction in LTCI of 4% at facility sector. However, special attention relies on the provision of IADL support services by the New Preventive Benefits contained in the law amendment. Ikegami (2007) suggests it is doubtful the new preventive services will be able to postpone or reverse further decline in elderly, rather it should be successful in containing expenditures by

restricting the provision of IADL support services in those eligible for the two lightest levels.

Concerning to in-home services, where cost contain through direct benefits cut back has been more difficult and complex, the implementation of NPB underlies indirect restrictions to the use of benefits by reducing uppers limits of benefits and/or fixing fees of some of the most currently services used [5,8]. Basically, the provision of the new preventive services intended to prevent elderly from becoming dependent while their need level are kept low. Initially LTCI was focused on providing services to dependent elderly; however the focus changed to the "prevention of the need for care" after the revision of LTCI law.

The present study was performed to examine the effect of the NPB scheme on the pattern of consumption services and expenses associated in the two lightest levels of the current users of LTCI system in city A. Then, we will drive the discussion counterpointed the main measures contained in NPB scheme remarking these effects on services utilization and expenditures of the current users of LTCI system in city A.

The NPB implies the reexamination of the scope of the eligible persons. The recertification process of current users at Support Level and Care Level defines new limits of the benefits. The net effect of this process on the limits of benefits depends on, previous care level of the subjects and the new care plan designed jointly with managers at LCSCs level. Approximately 40% of the certified elderly of the system is expected to be in the "new support" categories. However, in city A at the end of the study period a 44 % of the users in Support level and Care level 1 has been recertified to the "new support" categories.

One the one hand, the subjects coming from Support Level and recertified to Support Level 1, they have a potential reduction of 19% of the maximum benefits for in-home services. However, in our cohort, subjects reclassified in Support Level 1, shows a real reduction of the utilization of benefits units of 33% compared with their previous utilization before the revision Law. This reduction could be explained by an overlap effect of the factors as, a reduction on utilization of services and/or a change in the care-mix of services promoted by the new scheme. A significant change in the care-mix of this assistance category was demonstrated in our study.

On the other hand, users recertified as Support Level 2 when are compared with Support Level and Care Level 1 pre-revision 2006, increased by 69% and decreased 37% their potential of benefits, respectively. In our study cohort, the subjects recertified as Support Level 2 coming from Support level increased 14% their utilization of benefits units compared with their previous entitlement. However, subjects coming from Care Level 1 increase by 28% the utilization of benefits in this new category. A relevant finding in this category is a change of the pattern of care-mix of services. A significant decrease of utilization of "home help services" by users and an increased use of the commuting services i.e. "day services" and "outpatient rehabilitation" was observed.

On the perspective to control the supplier-induced demand established on the NPB scheme, we

did not explore the relationship between consumption pattern of services and care management. This is a limitation of this study. The management (care planning) for these new preventive benefits is supervised and contracted either directly by the municipalities (by communities with a population of 20,000 – 30,000 inhabitants) or contracted out by selected agencies. It can be supposed that in this way a better control of the expenses linked to NPB can be achieved. However, the effect of care management control could be deducted from the efficacy of the LCSCs center implementation and indirectly from the magnitude of the recertification process. By the end of April 2006, 88% of all the 1,690 insurers (representing 1,842 municipalities) had established one or more LCSCs and by the end of the study period in city A, 44 % of the users in Support level and Care level 1 has recertified in the "new support" categories.

As new preventive services have not time requirements because the type and amount of services are adjusted to the specific needs of users and the new monthly fixed fees for three of them –"home help services", "day services" and "day rehabilitation services"-, government expected to lower payouts of LTCI. We demonstrated an increase utilization of benefits units by these three services in the "new support" categories, especially by "day services". Furthermore, a decrease of the average days used in these services was observed, particularly in subjects belonging to Support Level 1.

Changes of the care-mix of services were demonstrated in subjects of the lowest need categories by the end of study period. In the "new support" categories, utilization of in-home services i.e. "home help services" and "leasing welfare appliance" has been clearly replaced by commuting services; "day services" and "outpatient rehabilitation" represent more than a 50% of the services used by recipients of this new categories at the end of the study period. As it was mentioned above, three of these services have new monthly *fixed* fees then, it is predictable that this trend has also economical effect on the expenditures. Furthermore, subjects recertified in Care Level 1 by the end of study period, showed a care-mix of services compound basically by commuting services; 64% of the total days used in this category are explained by "day services" and "outpatient rehabilitation".

Regarding the effect of the LTCI reform on the expenditures, copayments and subsidies, we demonstrated a decrease in the total average expenditures, copayments and subsidies by person/year in this cohort by the end of the study period, but these differences were not significant. However, a "redistribution effect" of the expenditures carried out by care level and gender was observed. Subjects recertified in the "new support" categories in both genders, showed a decrease of the monthly average expenditures, particularly in subjects of Support Level 1 as the differences were statistically significant. Finally, we demonstrated a significant increase of the total individual expenditures during the year after the LTCI law amendment within subjects with the lowest expenses (under the median of a subset of the cohort) during the year before the revision. Conversely, in the same period a significant decrease of the total individual expenditure was demonstrated in subjects with the highest expenditures a year before the reform.

It must be pointed out that an unexpected finding was observed. A relative increase of the proportion of subjects belonging to Care Level 1 using *facility services* and a significant increase of the proportion of benefits units utilized in facilities services by them at the end of the study period was demonstrated. These changes could be explained by a scale up on the severity of care within subjects in Care Level 1 or might suggest a real substitution of in-home services for facility services in this care category, or both. The policy implications of this finding may lie on the accuracy of the Care Need Certification process of LTCI system and/or the manager role of the Local Comprehensive Support Centers on the care planning of those recipients.

2) Study2:

As the LTCI system has become established in Japanese society and the LTC supply has expanded, demand for LTC services has increased greatly and consequently the expenditures of the system are growing dramatically [9, 22]. In Japan, the total LTCI expenditure for FY2007 was ¥6.9 trillion (US$ 58.5 billion) representing 1.3% of GDP and a growth of 8.9% over the FY2006 budget [18]. In response to this, and beyond set prices and types of LTC services delivered, the Japanese government has instituted important changes, contained in 2005 LTCI Law amendment to ensure the sustainability of the system.

Most of the literature dealing with LTCI expenditures in Japan is at a macro-level and provides insight into complex and sensitive issues, such as future demand, costs, and financing alternatives in a country context. However, at the micro-level, namely, the LTC insurer or individual level, there have been few empirical studies concerning LTCI expenditures in Japan and the available studies have focused primarily on aggregate approaches related to supply/demand factors.

This study set out to investigate factors associated with the higher LTC expenditures in an elderly cohort from a Japanese city. Our results demonstrated that an increase in relative utilization rate of insurances benefits as main effect was a strong predictor of the higher LTC expenditures. However, an interaction between institutional care utilization and higher care needs level, also was a significant findings in our study. Finally, although only slight, our logistic regression model picked up a positive effects of age and decline in functional status on high LTC expenditures. These findings can be used in future studies to understand expenditures trends from LTCI system by targeting the high risk groups that have been identified.

In the LTCI system in Japan, on average, recipients use only 48% (2006) of their benefits entitlement (range, 37-54%), but this is steadily increasing. Certainly, the supervision by local government of the care manager's role is a crucial regulatory mechanism in this issue. Our results suggest that an increase in the relative URB is a strong predictor of high LTC expenditures. So we are probably noticing that utilization rate of benefits as an insurance variable, becoming a relevant factor involved in higher LTC expenditures. Then, under an insurer perspective the monitoring of

URB, could be considered as a reliable indicator of the care managers performance on LTC expenditures.

In the long-term care field, there is consensus that disability of elderly persons is the main factor driving the demand for LTC services, for community-based or institutional services. Obviously, care needs level of elderly per se it is not a direct factor associated with high LTC expenditures, but it is a strong predictor of the demand of LTC services and consequently an important factor to explain LTC expenditures. Our model was able to demonstrate a significant interaction effect between facilities services utilization and higher care needs level -as a static measure of the disability status - providing visualization of the combined effect of these two covariates. These findings could be explained by the increased demand for nursing homes and intermediate geriatric facilities observed in the LTCI system in Japan, even after enactment of the law in 2005 that reduced economic incentives for institutionalization. The annual demand for nursing home facilities in Japan has been increasing at a rate of 2-3% per year since 2006 due mainly to longer waiting lists for institutional care at the present.

Although not the primary focus of this paper, a moderate impact of age and decline in functional status on high LTC expenditures were observed in our study. In spite, earlier studies are well documented that disability status – rather than age per se – plays a pivotal role in long-term care expenditure predictions, it is interesting to notice that age, although slightly, appears to be a significant factor in our model, the age effect was only significant in female gender, thus we recommend precaution with the interpretation of this result. On the other hand, the effect of a dynamic dimension of the disability status, even slightly, became an additional and significant predictor for higher LTC expenditures. The positive association between higher LTC expenditures and a dynamic disability measure in the adjusted model could be explained by the fact that a decline in functional status over the study period, determines changes in consumption pattern of services due to increased frequency or change of the type of services which, in turn, cause an increase of the LTC expenditures. Thus, this finding address to a challenging economical issue as it is the evaluation of the cost-effectiveness of LTC services in Japan.

Gender differences and household incomes were not statistically significant in both univariate analysis ($p < 0.25$) and multivariate analysis in our model, probably as a result of the 'welfare" structure of LTCI system in Japan, due to the eligibility for benefits is based solely on need and does not take into account the financial position or family structure of the users. However, as difference by gender in Japan shows one of the highest gender survival gaps in the developed world (women outlive men by 7 years (2009)) a separate analysis by gender it was conducted and a two-way interaction between gender and age covariates it was also investigated. In the men strata model, age as continuous or categorical variable was not statistically significant associated with the high expenditures group. Whereas among women, age as a continuous variable or as the three age

categories, are statistically significant associated with the high expenditures group in a multivariate analysis (data not shown). The two-way interaction (gender*age) was not statistically significant in our model (data not shown). In spite of most of the men falling into youngest age categories in the target group, this effect it is not significant in a multivariate logistic model. Then, gender and household income were forced to stay in the model for controlling for their effects.

Despite a well documented literature on the importance of the role of the informal care provision in LTC systems and his economical effect on LTC expenditures, it should be notice that Japanese LTCI system –based on universal entitlements - does not consider any payment mechanism for family caregivers. Then, through lack of an informal care market is not possible to estimate informal care expenditures. In this context, just it is possible to estimates the opportunity-cost of time of the informal caregivers, but this issue is beyond the goal of this study. Furthermore, a recent study, based on data from a longitudinal survey of a nationally representative sample of the population over age 65 years in Japan, conclude that there is a substitution effect between formal and informal care but this effect vary by the characteristics of the informal caregiver. Thus, unmarried children -mainly daughter - and presence of children with a lower opportunity cost of time are more likely to provide care. Moreover, the results shows consistency with studies suggesting that actual of daughters-in-law, as the primary source of informal care under the traditional social norm, becoming less important in providing care than that of unmarried children.

Certainly, due to the nature of the data sources used, our analysis has several limitations. One weakness of our study and a possible source of information bias is that the data contain no information about supply factors (e.g., profit or ownership status of the providers, geographical density of providers or quality of services). Another possible source of information bias is that the data do not contain details about the potential influence of informal caregivers on expenditures. Another potential weakness is that our logistic regression model was not designed to control for possible endogeneity bias (i.e., an independent variable is correlated with the error term or an unobserved factor).

Finally, Fukawa, using a micro-simulation model based on physical disability, rather than age, concluded that estimates of LTC expenditures for the elderly in Japan will increase rapidly, rising to 3–4% of GPD by 2050. Concerning the sustainability of the LTC system, this author suggested that the only positive way to contain the expansion of LTC expenditures was to prevent the elderly from becoming dependent. Additionally, we demonstrated that from a public insurer perspective, the disability level is not the sole factor that must be taken into account. Other factors, such as an increase in the relative URB and the types of services delivered, primarily related to institutional care, contribute significantly to explaining the high expenditures in our study. Their potential impact in determining future trends in LTC expenditures in Japan should be considered in future models.