Archives of Gerontology and Geriatrics 78 (2018) 221–226

Contents lists available at ScienceDirect

Archives of Gerontology and Geriatrics

journal homepage: www.elsevier.com/locate/archger

Implementation of long-term care and hospital utilization: Results of segmented regression analysis of interrupted time series study

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ARTICLE INFO

Keywords:
Long-term care
Hospital
Length of hospital stay

ABSTRACT

This population-based time series study aimed to examine the effects of the long-term care insurance (LTCI) program on hospital utilization in Korea. Health insurance claim data and LTCI data were combined into a database of 92,596 individuals who were enrolled in Health Insurance at baseline. They were made of people who applied to LTCI program at least once since July 2008, and their hospital utilization records since 2002 were observed. Estimates of length of hospital stay (LOS) after the introduction of LTCI program were calculated using a segmented regression analysis. Although average LOS in hospitals implementation was lower pre-implementation period than post-implementation (16.865 days, SD: 4.864; 26.078 days, SD: 2.215, respectively, $p < .0001$), a decreasing trend was observed along the post-implementation period. The estimate for baseline trend, which reflect a trend in LOS before LTCI implementation, was 0.219 days ($p < .0001$). The estimate for *Level change after intervention* which is only indicated as the change of LOS was 2.821 days at the time of LTCI implementation, and was statistically significant ($p < .0001$). The estimate for *Trend change after intervention*, reflecting the trend in LOS after LTCI implementation, was −0.313, indicating a decreasing trend in LOS of −0.094 days ($p = 0.0055$), compared with the baseline trend. LTCI program was significantly associated with a decreasing trend in LOS. The results suggest that the introduction of LTCI program may have played a role in reducing LOS in older adults.

1. Introduction

Korea has a rapidly aging population, with the proportion of individuals aged 65 years or older expected to double from 10.3% in 2008 to over 20.8% by 2026 (Kim et al., 2011). The older population accounted for 32.4% of the total healthcare expenditure in 2010 (National Health Insurance Service (NHIS) (2011)), with hospitalizations driving up healthcare costs. The average length of hospital stay among hospitalized 65–69 old people and 80 years and above was 17.9 days and 35.6 days, respectively in 2008 (Do, 2009) and inappropriate hospitalizations in acute-care hospitals for elderly people led to longer stays. The increasing costs for inpatient care have been straining the National Health Insurance (NHI) system.

In 2008, the Korean government introduced a new social insurance scheme for long-term care insurance (LTCI) program, based on the experiences of other countries. The LTCI program provides social and supportive services for older people with functional limitations. The purpose of this program was to address changes in the pattern of morbidity from acute illness to chronic illness as a result of the rapidly aging population, and to reduce inappropriate use of healthcare services by older patients.

Since the introduction of the LTCI the number of eligible beneficiaries has consistently increased, from 146,643 in July 2008 to 341,788 in December 2012, with 88.0% of those eligible for the LTCI actually using long-term care services (National Health Insurance, 2018). The LTCI provides coverage for individuals aged 65 years and older and those less than 65 with geriatric diseases. Eligibility for LTCI is determined through the national care needs assessment system operated by the National Health Insurance Service (NHIS), where trained employees of NHIS and doctors evaluate the extent of the need for long-term care based on the applicant's levels of physical and cognitive functioning. As a result of the evaluation, a LTC grade is assigned for

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https://doi.org/10.1016/j.archger.2018.07.007
Received 20 January 2018; Received in revised form 8 July 2018; Accepted 8 July 2018
Available online 09 July 2018

each applicant, denoting how much help is required for an elderly person in their daily lives.

In Korea, since the introduction of LTCI, many studies have evaluated the effects of the LTCI program on depression and quality of life for family caregivers (Kim, Park, & K, 2010), scope of benefits (Jeong, 2010), and job satisfaction rates for LTC workers (Lee, 2011). A recent England study related to LTC indicated that since LTC services for the elderly population could reduce the rate of admissions to hospitals, the LTCI program could facilitate more timely discharge from hospitals (Forder, 2009). Tomita, Yoshimura, and Ikegami (2010) suggested that the use of LTC services decrease the probability of hospitalization by diminishing functional or health-related risks in Japan. However, no study has examined the effects of the Korean LTCI program on the utilization of healthcare services, using time series data. Because nine years have passed since the introduction of the LTCI program in Korea, it is important to evaluate the effects of LTCI on hospital utilization for the older population. The purpose of this study was to examine the effects of the LTCI program on the length of hospital stay (LOS) in hospitals for those aged 60 years and over, using a nationally representative data.

2. Methods

2.1. Data sources

This study used the National Health Insurance Service–Senior (NHIS-Senior) dataset from 2002 to 2013. The NHIS-Senior cohort was established by stratified systematic random sampling to generate a representative sample in 2002, with a 12-year follow-up until 2013. The dataset includes information on NHIS-Senior cohort members' application to LTCI, as well as their use of LTCI services, starting from 2008. The data comprise a nationally representative random sample of 558,147 individuals, approximately 10% of the population aged 60 years and older in 2002. For the analysis we included those who applied for the LTCI program at least once since July 2008 and their hospital utilization records since 2002, resulting in 92,596 subjects.

2.2. Dependent variable

The outcome measure was the length of hospital stay. Length of hospital stay was collected monthly, with person-month as the unit of analysis.

2.3. Covariates

Age, sex, residential region, insurance type, patient clinical complexity level (PCCL), income, admission type, primary diagnosis, season, admitted point after introduction of LTCI (per month), hospital type, and organization type were included as covariates. Residential region was categorized into metropolitan (Seoul), urban (Daejeon, Daegu, Busan, Incheon, Kwangju, or Ulsan), and rural (otherwise). PCCL was grouped into scores of 0, 1, 2, and over 3. Income was ranked from the lowest (Kim et al., 2011) to highest incomes (National Health Insurance, 2018), and grouped into quartiles using the SAS Rank function. Admission type was categorized into 3 groups: emergency, outpatients, and missing. Primary diagnosis was categorized into 19 disease categories, based on the international standard of classification. Season was grouped into 4 categories: spring, summer, fall, and winter. As a hospital level variable, hospital type was categorized into 4 groups: general hospital, hospital, long-term care hospital, and psychiatric hospital for the elderly. The organization type was categorized into 3 groups: public, corporate, and private.

2.4. Statistical analysis

Segmented regression analysis of interrupted time series analysis (Bernal, Cummins, & Gasparrini, 2017) was used to assess the effects of policy. It is a powerful method for estimating how much an intervention affects the outcome measure immediately and over time. Segmented regression models fit a least squares regression line in each segment and assumes a linear relationship between the independent variable and the outcome within each segment.

The segmented regression analysis equation was modeled as

$$Y_{it} = \beta_0 + \beta_1 \times time_t + \beta_2 \times LTCI\ implementation_t + \beta_3 \times time\ after\ LTCI\ implementation_t + \beta_4 \times season_t + \beta_5 \times X_{it} + e_{it}$$

where Y_{it} is the length of hospital stay during a time period t for unit i.

β_0 is the intercept.

time is a continuous variable starting from year 2002.

LTCI implementation is a binary variable (0 before June 2008; 1 after July 2008) *time after LTCI implementation* is a continuous variable started from August 2008 *season* is seasonality (spring, summer, fall, winter).

X_{it} is the covariate.

e_{it} is the error term.

Time after LTCI implementation was started in Aug 2008 because there was a 1-month lagged effect of LTCI. For this segmented regression analysis, a generalized estimation equation (GEE) model was used to account for correlations among individuals within each hospital. In SAS, the command PROC GENMOD can estimate Poisson and linear regression models (SAS Institute, 2004). A *proc genmod* was used for GEE with link identity, distribution normal, and AR (Kim et al., 2011). SAS 9.4 (SAS Institute, Cary, NC) was used in all analyses. All statistical tests were two-tailed, with the null hypothesis of no difference being rejected if $p < 0.05$.

3. Results

Table 1 shows the general characteristics before and after LTCI implementation at baseline. Among 92,596 participants, 68,443 (73.9%) utilized hospitals before the implementation of LTCI, and 24,153 (26.1%) utilized hospitals after LTCI was implemented. The average age of those who utilized hospitals before and after the implementation of LTCI was 71.9 years and 71.8 years, respectively, showing no significant difference ($p = 0.053$). The average admitted point for LTCI applicants was 30.0 points (SD: 35.9).

Table 2 shows the means of LOS for the pre- and post-policy implementation of LTCI. The difference in average LOS of subjects before (16.865 days, SD: 4.864) and after (26.078 days, SD: 2.215) the implementation was 9.213 ($p < .0001$).

Table 3 and Fig. 1 show the estimated regression coefficient and trend graph of LOS for baseline trend, level change after intervention, trend change after intervention. The estimate for *baseline trend*, 0.219 ($p < .0001$), reflects a trend in LOS prior to LTCI implementation. The estimate for *level change after intervention* reflects the change of LOS at the time of LTCI implementation. LOS increased by 2.821 days at the time of LTCI implementation ($p < .0001$). The estimate for *trend change after intervention* reflects trend in LOS after LTCI implementation. Thus, an estimate of −3.313 indicates that the trend in LOS decreased by −0.094 days ($p = 0.0055$), compared with the baseline trend.

In the subgroup analyses by age and hospital type (Table 4), the baseline trend, level change after intervention, and trend change after intervention were similar to that of the total sample.

4. Discussion

In this study, our primary purpose was to investigate whether implementation of long-term care affects length of hospital stay via segmented time series analysis using 12 years' database in Korea.