



# Length of stay and readmission in lumbar intervertebral disc disorder inpatients by hospital characteristics and volumes

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## ABSTRACT

In South Korea, lumbar intervertebral disc disorder (LIDD) patients are increasing in all age groups due to an aging population and changes in lifestyle, like sedentary, and there has been concern about reducing quality of care and increasing healthcare expenditure. Therefore, we aim to study the impact of hospital volume and hospital staffing, such as neurosurgeon or nurse, for length of stay or readmission in LIDD inpatients. We used health insurance claim data from 157 hospitals, consisting of 88,949 inpatient cases during 2010–2013. Multi-level models were analyzed to examine the association between LOS/readmission and both inpatient and hospital level variables. By the results, the average LOS was 10.85 days, and readmission within 30 days after discharge was 1063 (1.2%) cases. Higher hospital volume or number of neurosurgeons/ doctors showed inverse relation with LOS (per increases 100 cases =  $\beta$ :  $-0.0457$ ,  $P$ -value  $< 0.0001$ ; per increases 1 neurosurgeon =  $\beta$ :  $-0.3517$ ,  $P$ -value  $< 0.0001$ ; number of doctors per 100 beds =  $\beta$ :  $-0.1200$ ,  $P$ -value  $< 0.0001$ ). And, higher number of registered nurses (RNs) showed inverse relation with early readmission. In conclusion, higher volume or staffing showed positive relation with improving efficiency and quality in care of LIDD. Therefore, health policy makers should consider providing incentives or motivation to hospitals with higher volume or more superior hospital staffing for effective management of excessive healthcare expenditure or reducing quality of care.

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## 1. Background

Lumbar intervertebral disc disorders (LIDD) are frequently encountered health problems [1]. LIDD, defined as

functional and structural defects of the intervertebral disc from thoracic to sacral, may result from genetic, degenerative, or socioeconomic factors and induce back or leg pain, numbness and weakness [2,3]. In South Korea, LIDD patients are increasing in all age groups due to an aging population and changes in lifestyle, like sedentary [4].

Such increases were accelerated by introduction of the National Health Insurance Service (NHIS). Although accessibility to health care has rapidly increased for South Koreans by that system, it seemed like two sides of the

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same coin [5]. There were explosive increases in demand for health care, and many health care providers expanded their business in order to make more profit [6]. However, hospitals have finally faced difficulties due to growing competition and market saturation. According to OECD health data, the number of hospital beds is higher in South Korea compared to other OECD countries and those numbers also gradually increased (South Korea: 9.6 beds per 1000 population, Average of OECD: 5.0 beds per 1000 population; Y2011) [7]. To achieve a breakthrough, each hospital wanted to maintain their hospital occupancy in order to survive. As a result, average of length of stay (LOS) in South Korea also increased compared with other countries (South Korea: 16.4 days, Average of OECD: 8.0 days; Y2011) [8]. In South Korea, the payment system consisted of Fee-For-Services (FFS) and DRG (only for 7 disease groups) separately. Based on the payment system, management of LOS in each hospital is divided in two ways based on their characteristics and performance. First, hospitals want to increase LOS because medical profits increase per inpatient day. Under FFS, hospitals with low bed occupancy are often motivated to make profit through longer LOS. Therefore, average LOS was longer than other developed countries implementing DRG systems. On the other hand, most large-sized hospital tend to reduce LOS. This is because they already have high hospital occupancy and want to increase revenue by increasing patient turnover.

By the previous studies, excessive LOS has a negative impact on health care outcome as well as greater cost burden of patient. In addition, it causes difficulty in effective management of hospital, and it conclusively increased the burden of the national budget [9]. Thus, the importance of LOS management emerged to control the increasing medical costs. However, such controls can also often accompany readmission issues because hospitals reduce LOS to increase revenue from surgical services by increasing patient turnover, in which reduced LOS may threaten quality of care and patient outcomes when patients are discharged too early to get prepared to take themselves at home and become consequently readmitted to hospitals. It adversely affects patients and increases the cost burden of NHIs [10,11]. Finally, those problems have not been well managed in South Korea. According to Health Insurance Review & Assessment Service (HIRA), the total medical expenditure of LIDD has gradually risen from 67 million dollars in Y2006 to 110 million dollars in Y2013, and the number of LIDD surgeries has also risen. This increase is about 5 times the increase in U.S.A. [12]. Thus, it is worthwhile to investigate factors associated with health care outcomes of inpatients due to LIDD.

So far, although many previous studies regarding healthcare outcomes have been conducted, most of them have focused on relationship between surgical outcomes and factors in relatively serious diseases such as cancer, acute myocardial infarction, and stroke [13–15]. However, to the best of our knowledge, few studies related to outcomes of LIDD have been reported. Therefore, we aim to study the impact of hospital volume and hospital staffing, such as neurosurgeon or nurse, for length of stay or readmission in LIDD inpatients. Length of stay or readmission are one of factors which can reflect efficiency or serve as

quality indicators for hospital performance [16,17]. Based on these results, we expected to suggest an effective alternative for managing expenditures and quality.

## 2. Methods

### 2.1. Study population

There were approximately 1730 hospitals including 40 public hospitals during 2010–2013 in Korea. Although it would have been ideal had we been able to use data from all hospitals in South Korea, there were some difficulties in accessing patient information due to ethical issues and it was required to extract representative hospital samples effectively. Therefore, the data used in this study only included 160 hospitals (120 private and 40 public) extracted using propensity score matching-methods (1:3) adjusting for region of hospitals, nursing staffing level, total number of beds, number of intensive care unit beds, number of emergency room beds, and number of doctors. Among 160 hospitals, we excluded hospitals without lumbar intervertebral disorder (International Classification of Diseases groupings, ICD-10: M51) inpatient cases ( $N = 3$ ). We excluded cases without variables related to this study. Afterwards, 88,949 inpatient cases from 157 hospitals (public = 3 vs private = 118) were included for analysis. The unit of analysis was each hospitalization rather than patient.

### 2.2. Variables

#### 2.2.1. Outcome variables

To measure outcomes in lumbar intervertebral disorder inpatients, we used length of stay (LOS) and readmission within 30 days after discharge as outcome variables. Each indicator was usually used as an efficiency or quality indicator for hospital performance [16,17]. LOS was defined as subtracting day of admission from day of discharge. Although the data used in this study were composed of unit of inpatient cases, information about whether each inpatient case was readmitted to hospital due to the same diagnosis with index hospitalization was added to each inpatient case. Readmission within 30 days after discharge was defined as readmission due to LIDD within 30 days after first index discharge of hospitalization due to LIDD in the calendar year.

#### 2.2.2. Independent variables

The primary variables of interest in relation to LOS and readmission were hospital volume and hospital staffing. Hospital volume was defined as total volume of inpatients who were hospitalized due to lumbar intervertebral disorders in each hospital during total study periods. Hospital staffing included number of neurosurgeons, registered nurses (RNs), certified nursing assistants (CNAs), and doctors. The number of RNs, CNAs, and doctors was defined as the total number of staffing per 100 hospital beds. The difference between registered nurses (RNs) and certified nursing assistants (CNAs) in Korea comes from education and the licensing system. RNs must pass a national RN licensing examination and be licensed by the Korean

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