

# Registered nurse skill mix and staffing level determinants in long-term care hospitals

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## Abstract

Using a three-year database from 376 long-term care hospitals, we conducted a panel analysis study on the relationships between institutional operations; regional, patient, and medical fee characteristics of long-term care hospitals; and nurse staffing levels and skill mix over time. Nursing staff per bed in long-term care hospitals has increased, but the percentage of registered nurses among staff has decreased yearly since 2008. Assistants primarily provide nursing service in long-term care hospitals. We applied the market share of regional general hospitals and long-term care hospitals among all medical institutions by using the Herfindahl-Hirschman Index. Additional nursing staff members were not obtained when the bed capacity of long-term care hospitals increased. The percentage of registered nurses decreased despite the increase in nursing staff as the long-term care hospital market became monopolized.

**Keywords:** Herfindahl-Hirschman Index, Long-term care hospitals, Nurse staffing level, Nurse skill mix.

This study was supported by the HIRA Research Fund in 2010. This study is a secondary analysis of the data generated in the study that received approval from the HIRA Research Committee in 2010.

## Introduction

In South Korea (hereafter, "Korea"), medical law enforcement standards established long-term care hospitals as official medical institutions in July 1994. In article 3, section 2 of Korean health law, a long-term care hospital is defined as "a hospital which has bed capacity to provide medical services for patients requiring long-term hospitalization." There were 19 long-term care hospitals in Korea before 2000 and 361 in 2006. However, this number increased rapidly to 867 in 2010 and 1,232 in December 2013 as a result of the Korean government's support of long-term care hospitals and expectations for the industry due to population aging [1,2]. In comparison to acute hospitals, a long-term care hospital provides medical services focusing on care rather than cure. Long-term care hospitals also provide proper long-term care services for elderly patients with chronic diseases. Therefore,

it is crucial to improve the quality of nursing services provided by the increasing number of long-term care hospitals.

Previous studies have shown that the number of nursing staff affects the quality of medical services [3-10]. A high percentage of registered nurses (RNs) positively affects nursing service-related outcomes (e.g., reduced mortality) in long-term care hospitals [11]. The number of RNs is an important factor for the quality of medical services. However, nursing shortages have become a global phenomenon, similar to Korean hospitals. Moreover, RN supply is lower in long-term care hospitals than it is in acute care hospitals. In fact, long-term care hospitals in Korea legally allow the replacement of RNs with nursing assistants for up to two thirds of their RN quotas. Because of this, suspicions are rising that RNs are being replaced by nursing assistants in long-term care hospitals due not to the overall nursing shortage, but to business-related issues. The percentage of RNs varies across long-term care hospitals depending on the nursing supply environment.

Skill mix is defined as a combination of human resources from different categories hired to provide patients with nursing services [12]. Nurse skill mix is calculated as the percentage of RNs in the nursing staff. Kane et al. [13], in an analysis of 28 studies, showed that patient mortality and negative outcomes decreased with a higher rate of RNs; the percentage of licensed practical nurses was found to be associated with increases in negative patient outcomes.

Nurse staffing level and nurse skill mix directly affect nursing services and systemic productivity. However, as mentioned above, nurse staffing levels can vary depending on institutions' business motives in addition to medical institution type, regional characteristics, and nursing workload based on patient severity. Therefore, this study intended to provide preliminary data for managing the quality of nursing services in long-term care hospitals by investigating the determinants of nurse staffing levels and nurse skill mix. In particular, this study focused on the expansion of bed capacity and regional characteristics, which affect nurse supply and patient demand. Market size and the degree of competitiveness were considered regional characteristics that reflect the location of long-term care hospitals.

The long-term care initiative allowing for institutional approval of the replacement of RNs with nursing assistants was introduced in 2008. This study investigated the change in the number of nursing staff and the percentage of RNs among nursing staff from 2008 to 2010, as well as institutional, regional, patient, and fee characteristics related to this change. The specific objective was to determine the quality level of hospital care services. Second, we investigated institutional characteristics of hospital care, regional characteristics, patient characteristics, and operating results, and assessed their effect on the number of nursing staff. Third, we investigated the effects of institutional characteristics of hospital care, community characteristics, patient characteristics, and operating results on nurse skill mix.

## Methods

### Design

This study was a panel analysis study that investigated the change in nursing staff levels and the percentage of RNs among nursing staff from 2008 to 2010. We also investigated factors affecting the number of nursing staff and nurse skill mix, including institutional operation; regional, patient, and medical fee characteristics of long-term care hospitals; and nurse staffing levels and nurse skill mix.

### Data

Participants were selected from 376 long-term care hospitals that were in constant operation for three years from January 1, 2008 to December 31, 2010. This study was designed to reflect the location environment and changes in market competition for the selected long-term care hospitals. Study data included general information on long-term care hospitals from the HIRA, a report on the number of nursing staff, patient evaluation results, and medical billing details.

### Variables

Number of nursing staff and nurse skill mix were analyzed as dependent variables. Independent variables were divided into 1) institutional characteristics, 2) regional characteristics (location environment), 3) patient characteristics, and 4) medical bill features. The major observational independent variables in this study were the presence or absence of bed capacity expansion in each hospital, spatial variations of regional medical institutions, and degree of monopolization (competition) of long-term care hospitals.

### Dependent variables

The number of nursing staff per bed was calculated by dividing the total number of nursing staff, including both RNs and nursing assistants, by the total number of beds in each long-term care hospital. Nurse skill mix was defined as the percentage of RNs among the total nursing staff in each long-term care hospital. It was calculated by dividing the number of RNs by the total number of nursing staff.

### Independent variables

The effects of institutional (hospital) characteristics of long-term care hospitals on the dependent variables was assessed; the institutional (hospital) characteristics included the owners,

number of doctors, bed capacity, and change in bed capacity (whether the bed capacity increased in comparison to the previous year's bed capacity). The owners were classified as public (national and public), private corporations, or individuals. A total of 376 long-term care hospitals were classified as public, corporate, or individual. The number of doctors was calculated as the number of doctors per bed considering the bed capacity of each long-term care hospital. Additionally, for change in bed capacity, hospitals were classified into institutions with increased, maintained, and reduced bed capacity in comparison to the previous year's data.

### A. Regional characteristics

For regional characteristics (location environment) of the location of long-term care hospitals, urban scale variables, characteristic variables of hospital classification, and market competition between hospitals were considered.

- i. *Urbanization and urban scale*: Classifications were metropolitan, small city, and rural based on the size of the areas in which long-term care hospitals were located. The urban scale was based on population size.
- ii. *Herfindahl-Hirschman Index*: The degree of monopolization in regional long-term care hospitals: Lastly, the degree of competitiveness of long-term care hospitals in each area was calculated using the Herfindahl-Hirschman Index (HHI). The HHI is the most common indicator for determining market concentration and is calculated by summing the squared values of the hospital bed market shares of the long-term care hospitals in each area. That is, HHI reflects the degree of monopolization in the market concentration of long-term care hospitals in the areas.

### B. The characteristics of patients in long-term care hospitals

The characteristics of patients in long-term care hospitals (an operation outcome) were also assessed. The number of patients per bed was included to consider the patient turnover rate. In Korean long-term care hospitals, the hospital admission deductible system is implemented when the hospital stay lasts more than 180 days. For the inpatient characteristic variables, the number of patients per hospital, age composition, and patient severity composition were calculated using the HIRA data. The detailed calculation is as follows.

- i. *Number of inpatients per bed*: The number of inpatients was calculated as the number of inpatients per bed considering bed capacity.
- ii. *Patient severity*: In this study, the severity of patients in each hospital was evaluated depending on the number of patients per patient classification. Patients were classified into seven categories—clinically complex, special care, extensive services, behavior problems, impaired cognition, rehabilitation, and reduced physical function—based on patient assessment at the time of admission to long-term care hospitals. The ratio of the number of patients who fell into the categories above extensive services

(clinically complex, special care, and extensive services) was calculated based on patient classification standards. Moreover, medical severity was determined by calculating the ratio of patients who fell into categories above special care (clinically complex and special care) to patients above extensive services. Patients were considered to be in the reduced physical function group if, for them, either outpatient services or long-term care facilities was more suitable than inpatient services. The percentage of patients in the reduced physical function group among patients with extensive services and below (extensive services, behavior problems, impaired cognition, rehabilitation, and reduced physical function) was calculated.

We also assessed the characteristics of inpatient medical fees in long-term care hospitals (as an operation outcome). Fee-for-service rate was used to assess inpatient fees in long-term care hospitals. Long-term care hospitals primarily use a daily charge per-patient classification for inpatient medical fees, and partially use fee-for-service. Thus, it is necessary to consider fee-for-service beyond daily charges. The fee-for-service rate was calculated by dividing the inpatient medical fee, which is the combination of daily charge and fee-for-service, by fee-for-service.

**Data Analysis**

Time-fixed effects uniform panel regression analysis was conducted using SAS Enterprise Guide 4.3. This study was analyzed as follows. First, the general variables were analyzed using descriptive statistics. Second, the relationship between nursing staffing level and these related factors was examined using time-fixed effects panel regression analysis. The estimation equation was as follows:

$$NW_{i,t} = b_0 + b_1X1_{i,t} + b_2X2_{i,t} + b_3X3_{i,t} + b_4X4_{i,t} + \epsilon_{i,t}$$

( $\epsilon_{i,t} = \mu_i + \lambda_t + \gamma_{i,t}$ )

for

$i = 1, \dots, N$   
 $t = 2008, 2009, 2010$   
 where  $NW_{i,t}$  = nursing workforce of organization  $i$  in year  $t$ ;  
 $X1_{i,t}$  = vector of organizational characteristics of organization  $i$  in year  $t$ ;  
 $X2_{i,t}$  = vector of regional characteristics of organization  $i$  in year  $t$ ;  
 $X3_{i,t}$  = vector of patients characteristics of  $i$  organization in year  $t$ ;  
 $X4_{i,t}$  = vector of economic results of organization  $i$  in year  $t$ ;  
 $\mu_i$  = unobservable individual effect;  
 $\lambda_t$  = unobservable time effect;  
 and  $\gamma_{i,t}$  = remainder stochastic disturbance term.

This study did not use a randomized sample from a population of long-term hospitals. Instead, we investigated all long-term care hospitals operating from 2008 to 2010.

**Ethical Considerations**

In this paper, we report a secondary analysis of the data from a study approved as an official project by the institutional review board of HIRA in 2010. The private information of each organization was coded during data analysis in order to blind the researchers. So, this study did not need the approval of the institutional review board.

**Results**

**General Characteristics**

Among the 376 long-term care hospitals, 32 (8.5%) were public, 191 (50.8%) were corporate, and 153 (40.7%) were private. The degree of aging (the percentage of patients over 65 years old) was 85.0% on average. The degree of super-aging (the percentage of patients over 80 among the patients over 65) was 49.4%. The number of doctors per bed was 0.03 on average. The percentage of RNs among nursing staff was 58.1%. The number of nursing staff per bed was 0.14 on average.

**TABLE 1. General characteristics**

Variable	Values	Total				2008				2009				2010			
		M	SD	n	%	M	SD	n	%	M	SD	n	%	M	SD	n	%
Owner	Private			153	40.7			153	40.7			153	40.7			153	40.7
	Corporate			191	50.8			191	50.8			191	50.8			191	50.8
	Public			32	8.5			32	8.5			32	8.5			32	8.5
Total number of beds		133	70.1			128	67.5			130	68.3			139.9	73.9		
Patients/bed		1.86	0.78			2.01	0.85			1.87	0.80			1.71	0.66		
Number of doctors/bed		0.03	0.01			0.03	0.01			0.03	0.01			0.03	0.01		
Number of RNs/bed		0.58	0.20			0.59	0.21			0.58	0.20			0.56	0.20		
Number of nursing staff/bed		0.14	0.04			0.13	0.04			0.14	0.04			0.15	0.05		
RN rate (%)		58.1	20.9			59.5	21.3			58.1	20.8			56.7	20.5		

RN: registered nurse; M: mean; SD: standard deviation

**Determinants of the Number of Nursing Staff per Bed**

We analyzed the factors influencing the total number of nursing staff (RNs and nursing assistants). Time effects, number of doctors per bed, percentage of RNs among nursing

staff, change in bed capacity compared to the previous year, HHI, percentage of patients in the above special care group in patient classification, and fee-for-service rates showed statistically significant relationships.

Specifically, the number of nursing staff has increased since 2008. There were no differences by hospital ownership. The number of doctors per bed was positively correlated with the number of nursing staff. The number of nursing staff was lower in hospitals with increased bed capacity than it was in hospitals with bed capacity that had been maintained in comparison to the previous year ( $\beta = -0.1008$ ,  $p = .0001$ ).

HHI refers to the degree of monopolization for long-term care hospitals alone. The number of nursing staff in hospitals increased with increasing monopolization (lower competition). Patient severity in long-term care hospitals was positively correlated with the percentage of patients above special care and the number of nursing staff. The fee-for-service rate showed a positive correlation with the number of nursing staff.

#### Determinants of Nurse Skill Mix

Next, we analyzed the long-term care hospital characteristics that affected the percentage of RNs. The following characteristics were statistically significant: owners, number

of doctors per bed, metropolis and small city on the urban scale, number of patients per bed, percentage of patients in the above special care group, and fee-for-service rates.

There was no difference between private and corporate institutions, but public institutions had a higher percentage of RNs than did private hospitals ( $\beta = 0.0512$ ,  $p = .0215$ ). The number of doctors per bed was positively correlated with percentage of RNs ( $\beta = 0.4743$ ,  $p < .0001$ ). Metropolis had a 5.09% lower percentage of RNs compared to rural areas. Small cities had an 8.86% higher percentage of RNs as compared to rural areas. The percentage of RNs decreased as the number of patients per bed increased ( $\beta = -0.0448$ ,  $p = .0223$ ). The percentage of RNs increased as the number of patients in the special care group increased ( $\beta = 0.2820$ ,  $p < .0001$ ). The percentage of RNs increased with the fee-for-service rate ( $\beta = 0.2391$ ,  $p < .0001$ ). The fee-for-service is the medical fee beyond the daily charge; it was more common in institutions with a high percentage of RNs.

**TABLE 2. Factors affecting nurse staffing level and nurse skill mix**

Variable	Value	Number of nursing staff per bed			Nurse skill mix		
		$\beta$	SE	p	$\beta$	SE	p
Intercept		-0.6438	0.4925	.1914	1.1246	0.2508	<.0001
Time effect	2009(Ref: 2008)	<b>0.0982</b>	<b>0.0281</b>	<b>.0005</b>	-0.0025	0.0144	.8605
	2010	<b>0.1550</b>	<b>0.0291</b>	<b>&lt;.0001</b>	-0.0064	0.0149	.6671
Owner	Corporate(Ref: Private)	-0.0005	0.0253	.983	-0.0033	0.013	.7944
	Public	0.0539	0.0434	.2145	<b>0.0512</b>	<b>0.0222</b>	<b>.0215</b>
Number of doctors/bed		<b>0.8778</b>	<b>0.2327</b>	<b>.0002</b>	<b>0.4743</b>	<b>0.1187</b>	<b>&lt;.0001</b>
Number of RNs/bed		<b>-0.3452</b>	<b>0.0584</b>	<b>&lt;.0001</b>			
Bed capacity change	Decreased(Ref: Maintained)	0.0261	0.0295	.3767	0.0154	0.0152	.3095
	Increased	<b>-0.1008</b>	<b>0.0259</b>	<b>.0001</b>	<b>-0.0222</b>	<b>0.0133</b>	<b>.0948</b>
Urban scale	Metropolis(Ref: Rural areas)	-0.0234	0.0359	.5142	<b>-0.0509</b>	<b>0.0184</b>	<b>.0057</b>
	Small city	0.0165	0.0346	.6334	<b>0.0886</b>	<b>0.0176</b>	<b>&lt;.0001</b>
Monopolization	HHI (monopoly: 1, perfect competition: 0)	<b>1.8106</b>	<b>0.3812</b>	<b>&lt;.0001</b>	0.1064	0.1958	.587
Patient turnover	Number of patients/bed	0.0958	0.0382	.0123	<b>-0.0448</b>	<b>0.0196</b>	<b>.0223</b>
Patient classification	Extensive services	0.1358	0.0964	.1588	-0.0144	0.0495	.7702
	Above special care	<b>0.2499</b>	<b>0.0744</b>	<b>.0008</b>	<b>0.2820</b>	<b>0.0373</b>	<b>&lt;.0001</b>
	Reduced physical Function	-0.0388	0.0519	.4542	-0.0352	0.0266	.1861
Rate of fee-for-service		<b>0.2039</b>	<b>0.05</b>	<b>&lt;.0001</b>	<b>0.2391</b>	<b>0.0247</b>	<b>&lt;.0001</b>
Adjusted R <sup>2</sup>		0.1074			0.1831		
Durbin-Watson D		2.059			1.708		

HHI: Herfindahl-Hirschman Index; RN: registered nurse; Ref: reference variable.

#### Discussion

The number of long-term care hospitals in Korea has increased rapidly since 2001. This quantitative growth has likely had a significant impact on RN supply in long-term care hospitals. In addition, the number of RNs is directly associated with the quality of medical services, given that nursing assistants can replace up to two thirds of RN quotas.

In this study, we found that the number of nursing staff per bed has been increasing since 2008. There is no difference by hospital ownership. The nurse skill mix has been declining since 2008. Additionally, there was no discrepancy in nurse skill mix between private and corporate hospitals, but it was 5.12% higher in public institutions than it was in private hospitals. Further, the percentage of RNs and nursing staff had a negative correlation and the substitution relationship of RNs

with nursing assistants was verified. This study shows that it is becoming challenging to obtain RNs (i.e., due to increased competition), and RNs are thus being replaced by nursing assistants. Moreover, obtaining RNs may be easier in public than it is in private hospitals, or there may be a higher tendency to replace RNs with nursing assistants in private hospitals. Regarding wages, hiring nursing assistants to replace RNs would be beneficial for business. However, the quality of nursing services will decline as RNs are replaced with nursing assistants. This result corresponds with that of Seago et al. [14], who found that for-profit organizations tend to have lower nurse staffing levels than do non-profit organizations.

Nursing staff is not supplied in proportion to demand when long-term care hospitals increase bed capacity. On the other hand, the number of nursing staff proportionally decreased when bed capacity decreased. In addition, the percentage of RNs declined as bed capacity increased. Thus, increasing bed capacity decreases the quality of nursing services. This reflects the reality that bed capacity can be increased according to patient demand, but it is challenging to supply nursing staff, and even more challenging to supply RNs.

Regional characteristics reflect the location environment that affects nurse staffing and patient demand in long-term care hospitals. The percentage of RNs was higher in small cities than it was in metropolitan or rural areas. This implies that the quality of nursing services in small-city long-term care hospitals is better than it is in rural and metropolitan hospitals. It may be the case that because there are many acute hospitals (e.g., general hospitals) in metropolitan areas, the number of nursing staff is relatively small; nursing assistants replace RNs in rural areas because of the difficulty in supplying RNs.

The degree of monopolization (competition) in regional long-term care hospitals was investigated using the HHI. According to the HHI and concentration evaluation standards, HHI values above 0.7 indicate that the type of competition is a monopoly and the degree of concentration is very low [15]. In this study, the number of nursing staff increased when the market of regional long-term care hospitals was monopolized. This suggests that long-term care hospitals in monopolized areas have a high tendency to replace RNs with nursing assistants. Seago et al. [14] reported that nurse staffing levels are higher in more competitive medical institutions. Kim [16] investigated the nurse staffing level per hospital classification for 43 general hospitals and determined that higher HHI values are associated with fewer hired RNs. Nurse staffing level was highest among hospitals with HHI values below 0.1. However, Kim [16] examined general hospitals, while this study examined long-term care hospitals. Nevertheless, it appears that as the percentage of RNs decreases, there is a decline in nursing service quality in monopolized markets.

Institutions with more patients per bed had higher nurse staffing levels but a lower percentage of RNs. Both nurse staffing level and nurse skill mix increased in institutions with a higher percentage of patients with greater severity of those requiring medical treatment. This suggests that both quantity and quality of nursing staff are important as severity increases.

Nurse staffing levels and percentage of RNs were higher in institutions with higher fee-for-service incidence rates. Long-

term care hospitals have been implementing the daily charge system since 2008; they determine daily charges by classifying patients into seven groups according to their resource utilization. The hospitals primarily implement daily charges, but apply fee-for-service for specialized items in order to maintain service quality. Since a high incidence rate of fee-for-service indicates a system that provides more specialized treatment and nursing services, this may explain the high percentage of RNs.

It is difficult to identify accurately the nurse skill mix in Korea due to a lack of actual condition surveys or research on nurse skill mix in Korea. Lee et al. [17] estimated and described the nurse skill mix based on the Ministry of Health and Welfare data on the status of RNs and nursing assistants. The percentage of RNs was 51.3% in long-term care hospitals, but 86.2% in general hospitals, demonstrating considerable differences by hospital type. Most studies have reported that a lower percentage of RNs negatively affects patient outcomes [13, 18]. Lin [7] reported that obtaining RNs significantly affects the quality of nursing services. There is no significant correlation between nursing assistants and quality of nursing. This study showed that the percentage of RNs varies depending on the percentage of patients with greater severity and the percentage of patients who do not require long-term care hospitalization. This indicates that the quality and quantity of nursing services in long-term care hospitals can vary by inpatient severity.

### Limitations

The significance of this study is that it investigated the determinants of nurse staffing level with nurse skill mix and the number of nursing staff, including RNs and nursing assistants, by considering institutional characteristics, regional characteristics, patient characteristics of operational outcomes, and medical fee features. We also considered these changes over time. In particular, this study differed from previous studies in the following two ways. First, differences in location environment of long-term care hospitals were reflected using HHI values. Previous studies considered only the HHI, an indicator of market competitiveness produced mainly at the regional level. This study additionally applied the market share of regional general hospitals and long-term care hospitals among all medical institutions by using the HHI. Second, patient severity was considered. This was possible because a daily charge system for each patient category was implemented in the inpatient medical fee in January 2008. However, this study has the following limitations.

First, we did not consider nurse employment patterns. At present, the nurse's license in Korea leads nurses to work mainly at acute care hospitals. The degree of nursing service provision is different between acute and long-term care hospitals. Moreover, new RNs are supplied primarily to acute hospitals. This study could only delineate the differences in nurse staffing level and the percentage of RNs based on regional differences. As we could not explain nurses' personal characteristics, the lack of such information limits the study results. Further, we did not account for the features of the nursing system. Finally, recruitment of excellent nurses based

on preference may be affected by economic factors in the labor market (e.g., labor size, profitability); however, this was excluded from the model.

### Conclusions

Nurses and nursing personnel, including a sufficient proportion of nurses and nursing assistants employed and holding a national license, directly affect productivity improvements in the quality and organization of nursing services. We investigated these effects by assessing the changes in the number of nursing staff and the percentage of RNs following the implementation of the nurse classification for long-term care hospitals in 2008 and the modified nurse classification in 2010 using the annual staff distribution (RNs and nursing assistants) in long-term care hospitals from 2008 to 2010. The number of RNs per bed in long-term care hospitals has increased, but the percentage of RNs in nursing staff has declined every year since 2008. This means that the nursing service in long-term care hospitals is mainly operated by nursing assistants. Further, additional nursing staff was not obtained when the bed capacity of long-term care hospitals increased. The percentage of RNs decreased despite the increase in nursing staff as the long-term care hospital market became monopolized.

Nurses and nurse assistants, as well as total nurse staff sizes, have been increasing since 2008. However, public institutions have been hiring more RNs than nurse assistants. Nurse recruitment is affected by urbanization. The recruitment of nurse assistants is influenced by the degree of monopoly in hospital care. More urbanized areas hire nurses to employ a larger workforce; it appears that nurse recruitment operates more smoothly in these areas. Conversely, the hospital nurse constituent ratio (nurse skill mix) was found to be rather low in the more exclusive (monopolized) areas of long-term care hospitals. Long-term care hospitals showed a tendency to employ nurses to account for the additional services required to increase the number of patients with significant disease. However, increasing the amount of healthcare services to be provided in response to the increased special care patient ratio led to an increase in the rates of fee-for-service (reflecting the medical need) and number of doctors, also increasing the composition ratio of nurses in long-term care hospitals. Hence, establishing nationwide policies for nursing staff distribution and monitoring is necessary for long-term care hospitals to obtain a proper workforce and provide high-quality nursing services.

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