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Research Article

# Nurse Staffing and 30-day Readmission of Chronic Obstructive Pulmonary Disease Patients: A 10-year Retrospective Study of Patient Hospitalization

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SUMMARY

*Purpose:* Chronic obstructive pulmonary disease (COPD) is a leading cause of morbidity in many countries, and it has high rate of hospital readmissions due to recurrent exacerbations of the disease. Many previous studies have suggested further examination of the factors that contribute to hospital readmissions of COPD patients. However, evidence on the effects of nurse staffing by registered nurses (RNs) on the readmission of COPD patients is lacking in Korea. The aim of our study was to evaluate the effects of nurse staffing on hospital readmissions of COPD patients.

*Methods:* We used National Health Insurance claim data from 2002 to 2012. A total of 1,070 hospitals and 339,379 hospitalization cases were included in the analysis. We divided the number of RNs per 100 beds and the proportion of RNs on staff to one of three groups (Q1: low; Q2: moderate; Q3: high). A generalized estimating equation model was used to evaluate the associations between readmission and nurse staffing.

*Results:* A higher number of RNs was associated with lower readmission rates of 8.9% (Q2) and 7.9% (Q3) respectively. A similar effect was observed as the proportion of RNs among the total nursing staff gradually increased, resulting in lower readmission rates of 7.7% (Q2) and 8.3% (Q3).

*Conclusions:* Our results suggest notable positive effects of nurse staffing by RNs on patient outcomes. In addition, the magnitude of impact differed between different sizes of hospitals. Thus, human resource planning to solve staffing shortages should carefully consider the qualitative aspects of the nursing staff composition.



## Introduction

Chronic obstructive pulmonary disease (COPD) is a leading cause of morbidity and mortality in many countries, and the societal burden of this disease has increased with the increasing prevalence of COPD and hospitalization [1,2]. Recurrent exacerbations of the disease were induced to such a high rate of readmission in COPD patient. One-fifth of COPD patients are readmitted within 30 days after discharge from the hospital [3]. Numerous factors that may be responsible for frequent COPD patient readmissions have been suggested. Earlier studies have suggested that related patient factors such as comorbidities, physical inactivity and smoking status were associated with an increased risk for readmission [4,5]. Other studies have suggested that hospital resources, including medical staffing, were associated with the readmission of COPD patients [6,7]. Since patient outcomes depend on the performance of those who deliver care, human resources are an important factor that cannot be ignored [8,9]. Nurse staffing is especially important because nursing

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demand is expanding to accommodate an aging population, so the demand for nurses is expected to continue its increase [10]. However, human resources are not always adequate to provide optimal patient care. There is a shortage of qualified human resources in many countries.

In Korea, nursing staff is classified as registered nurses (RNs) or certified nursing assistants (CNAs). The RNs are considered professional healthcare providers along with doctors, and are required to graduate from a university (4-year education program) or college (3-year education program) training program. In addition, they must pass a national RN licensing examination administered by the Ministry of Health and Welfare. The scope of performance for RNs in the Korean medical law included assisting doctors, and providing care to patients with injuries and sickness. In addition, RNs provide counseling with education to patients who needed nursing care, and health promotion activities to improve health status. CNAs are not classified as professional healthcare providers. The scope of performance for CNAs is based on enforcement of the Ministry of Health and Welfare in Korea, and they have the role of assistants for doctors and nurses. They are possible to providing the scope of performance of RN as a way of nursing assistant. CNAs are required to have a total of 1,520 hours of related education in an occupational high school or private educational institution, and pass a certification examination [11]. The role of CNAs in Korea is similar to that of licensed practical nurses in the United States [11,12]. However, CNAs in Korea do not have a license, and they have a certification for nursing assistant.

Although, nursing staff has increased gradually under the existing, specialized educational systems, the supply of nurses has not met the growing demand in Korea. Almost half of RNs were leaving their job within 3 years, due to dissatisfaction such as interpersonal relationship and working environment [13]. As a result, the high turnover rate of RNs induced a disparity between supply and demand. According to the Organisation for Economic Co-operation and Development (OECD) statistics for 2013, the number of nurses in Korea was lower than the average number of nurses on staff in other OECD countries, even when including CNAs (OECD: 9.1 nurses per 1,000 population; Korea: 5.1 per 1,000 population) [14]. Lower number of nursing staff imply an increased labor intensity and workload that results in lower quality care [15,16]. In addition, different staffing levels of RNs were also considered to be an important factor affecting patient outcomes [17]. Pioneers suggested that nursing staff levels were significantly associated with patient readmission rates and clinical outcomes [18,19]. In particular, high level of nurse staffing induced better outcome in clinical care for chronic diseases including COPD, chronic heart disease, and diabetes [19]. As chronic diseases needed long-term management for care, patient education and discharge planning during hospitalization was important for preventing unintended admission [20]. In addition, performance of such intervention was closely correlated with professional healthcare providers such as RNs. Thus, a low level of nurse staffing could possibly affect the risk of readmission in COPD patient. However, direct evidence on the influence of RN nursing staff on COPD patient outcomes is lacking in Korea. This information will aid the evaluation and improvement of human resource planning in hospitals.

The aim of our study was to evaluate the association between the level of nurse staffing and readmission rates of COPD patient. In particular, we considered the number of nurses and proportion of RNs separately to assess the exact effect of nurse staffing on patient outcome. In addition, we conducted subgroup analysis by type of hospital to evaluate different effects of nurse staffing on readmission of COPD patients.

## Methods

### *Study design*

We performed a secondary data analysis to examine the association between hospital nursing staff levels and patient readmission for COPD within 30 days. In addition, we did subgroup analysis by type of hospital to evaluate the effects of RN staff on the quality of care.

### *Setting and sample*

We used claim data from National Health Insurance Services for the analysis. The database consisted of hospitalization data that included patient admissions from January 2002 to July 2012. We selected patients who were admitted for COPD as the major diagnosis (International Classification of Diseases, ICD-10: J44). A total of 1,070 hospitals and 339,379 hospitalization cases were included in our analysis. The unit of analysis was the hospitalization case.

### *Ethical considerations*

We obtained approval from the Institutional Review Board (IRB) of the Graduate School of Public Health, Yonsei University (IRB no.: 2-1040939-AB-N-01-2016-218).

### *Measurement*

The outcome variable in this study was readmission to the hospital within 30 days after discharge for COPD. We first identified the dates of the patient's first hospitalization and discharge in the calendar year. Next, we considered whether there was a readmission within 30 days after the discharge date. Readmission was defined as a new inpatient hospitalization within 1–30 days, of the first discharge date.

The number of active nursing staff was determined for the different hospitals, including the number of RNs per 100 beds and the proportion of RNs among the nursing staff. The proportion of RNs on staff was defined as the number of RNs/(number of RNs + number of CNAs). Based on the number of RNs per 100 beds and the proportion of RNs on staff, each institution was assigned to one of three groups according to quartiles where Q1 was low, Q2 was moderate, and Q3 was high. Q2 included that from the first quartile (median of the lower half, 25%) to the third quartile (median of the upper half, 75%).

We adjusted for the inpatient and hospital variables when analyzing the relationships between the number of RNs per 100 beds and the proportion of RNs, on the rates of readmission within 30 days after discharge. The patient variables included in the analysis were major diagnoses, age, sex, respiratory impairment grading [21], comorbidities, duration of oxygen therapy, length of stay (days), length of stay in an intensive care unit (ICU), type of health insurance, and hospitalization year (2002–2012). The patient's respiratory impairment grading was classified from grade 1 to grade 3, based on testing of forces expired volume in 1 second (FEV1) and arterial oxygen tension (PaO2). Grade 1 was defined as patients who had severe dyspnea requiring oxygen therapy and FEV1 $\leq$ 25.0% predicted or resting PaO2 $\leq$ 55 mmHg (room air). Grade 2 was defined as patients who had dyspnea when walking at home and FEV1 $\leq$ 30.0% predicted or resting PaO2 $\leq$ 60 mmHg (room air). Grade 3 was defined as patients who had dyspnea when walking at their own pace on level ground and FEV1 $\leq$ 40.0% predicted or resting PaO2 $\leq$ 65 mmHg (room air). Comorbidity was attributed to patients who had hypertension, diabetes, heart disease, or any other disease. The duration of oxygen therapy corresponded to the number of days that an inpatient received oxygen therapy during their hospitalization.