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Effect of the Partnership Nursing Model on In-hospital Mortality in Japan

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ABSTRACT

The partnership nursing model involves nurses working in pairs to provide care for patients. To explore the influence of this care-delivery model on patient outcomes, we examined in-hospital mortality data from Japanese university hospitals that have adopted the partnership nursing models (Partnership Nursing System® or Kanazawa University Hospital Interactive Nursing Development) and other nursing models. We also investigated the influence of implementing 1:7 nurse-to-patient ratio in partnership nursing (PN) hospitals and non-PN hospitals. This study involved 42 national medical university hospitals in Japan and utilized publicly available information such as hospital and governmental websites as well as the Japanese Diagnostic Procedure Combination database (which concerns various characteristics of hospitals), literature on nursing delivery models, nurse-to-patient ratio data, and in-hospital mortality trends focusing on the period between 2006 and 2014. We assessed these mortality trends within partnership nursing hospitals and non-partnership nursing hospitals using a linear regression model. The national university hospitals that employed the paired nursing delivery model (n=11) showed a non-significant trend in in-hospital mortality (p=0.05) between 2006 and 2014; conversely, non-partnership-nursing hospitals (n=8) exhibited a significant declining trend in in-hospital mortality (p=0.004) during this same period. In-hospital mortality trends differ between hospitals that implement the partnership nursing model and those that do not use this care-delivery model. While we were unable to adjust for patients' and healthcare professionals' background factors due to limitations of publicly available information, more rigorous future studies are suggested to further examine the association of the partnership nursing model on in-hospital mortality. *Ryukyu Med. J., 38 (1~4) 89 ~97, 2019*

Key words: hospital mortality; 1:7 nurse-to-patient ratio; partnered nursing care; university hospitals

INTRODUCTION

The Partnership Nursing System® (PNS) is a new nursing delivery model that involves assigning a pair of nurses to each patient[1]. This system was devised in 2009 and implemented in 2011 by Fukui University Hospital in an attempt to overcome patient-safety issues resulting from the 1:7 nurse-to-patient ratio adopted in Japan in 2006. The PNS has gained popularity over the past six years, and the number of Japanese hospitals implementing it continues to increase; however, alternatives have also been suggested. For example, Kanazawa University Hospital has introduced a similar paired-nursing model called "KIND" (Kanazawa University

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Hospital Interactive Nursing Development); the main difference between the PNS and KIND is that KIND does not divide ward nurses into teams, while the PNS creates several teams led by deputy head nurses[2]. Another similar model is "preceptorship" (which also involves nurses working in pairs), though an obvious difference is that preceptorship focuses on using the partnering model to assist newly graduated nurses, while in the partnership nursing (PN) model, all nurses, including experienced ones, work in pairs for all duties (from providing patient care to conducting committee activities).

Japan implemented the 1:7 nurse-to-patient ratio for hospitals providing high-quality medical care as an improvement over the previous best ratio (1:10). In 2007, one year after the passage of this new ratio, 21 national university hospitals were approved for the 1:7 nurse-to-patient ratio, and by 2013, all 42 national university hospitals had received approval[3]. Because of this sudden change, many new graduate nurses were hired over a short period, fueling quality and safety concerns regarding the nursing care level[1, 4].

In traditional care-delivery models, the quality of nursing care is heavily influenced by individual nurses' knowledge and skills. When methods are applied that involve a pair of nurses observing and assessing a patient's condition, providing treatment, and discussing any related issues, it is assumed that patient safety and the quality of nursing care delivered is improved; however, with the partnership model, there is also the disadvantage that the number of patients each nurse is responsible for could be doubled.

Previous studies based in the United States[5], European countries[6], and South Korea[7] have focused on the relationship between nurse staffing and patient mortality, each finding that every additional patient assigned to a nurse has a 5—7% higher odds of dying. Further, in the United Kingdom, hospitals with ≦6 medical patients per nurse have an 11% lower mortality rate compared to those using a ratio of >10 patients per nurse, although this difference is non-significant when including surgical patients[8]. In Japan, no prior research has examined whether the implementation of the 1:7 nurse-to-patient ratio or PN models have resulted in better patient mortality.

Study Aims

This study compares in-hospital mortality, one of the quality indicators used in hospitals worldwide[9, 10],

between hospitals that use a PN model and those that do not. Furthermore, we investigated the influence of implementing 1:7 nurse-to-patient ratio in PN hospitals and non-PN hospitals.

METHODS

Study Design and Setting

This research constitutes a study of publicly available databases and compares in-hospital mortality trends within Japanese national university hospitals that have adopted the either the PNS or KIND PN models (PN hospitals) with those that have applied other nursing models (non-PN hospitals). A flowchart of the hospital selection process is depicted in Fig. 1. For our sample, we chose to only include national medical university hospitals, excluding dental and research hospitals and hospitals that did not provide a description of their nursing delivery model(s). Further, we excluded hospitals that adopted the 1:7 nurse-to-patient ratio after 2007, to avoid the influence of changes in this care ratio on patient mortality. We also excluded hospitals that implemented a PN model after 2013 and those that did not specify the year in which it had been adopted. It should be noted that one hospital in the non-PN group was excluded because it had implemented a PN model between 2012 and 2014, but stated that the nursing model following that period was fixed-team. As a consequence, we classified 11 hospitals as PN hospitals and eight hospitals as non-PN hospitals for the purposes of this study.

Considering that the partnership nursing model was initiated to overcome safety concerns emerging from the employment of a large number of newly graduated nurses to meet the requirement for 1:7 nurse-to-patient ratio[1, 4], the influence of 1:7 nurse-to-patient ratio might differ between PN and non-PN hospitals. In order to investigate the influence of not only partnership nursing models but also 1:7 nurse-to-patient ratio on in-hospital mortality, we examined the trend of in-hospital mortality in PN and non-PN hospitals from 2006 (one year prior to the implementation of 1:7 nurse-to-patient ratio in the hospitals) to 2014.

Definitions

PN-hospitals: national university hospitals that implemented the 1:7 nurse-to-patient ratio in 2007 and had adopted a PN model by 2013.
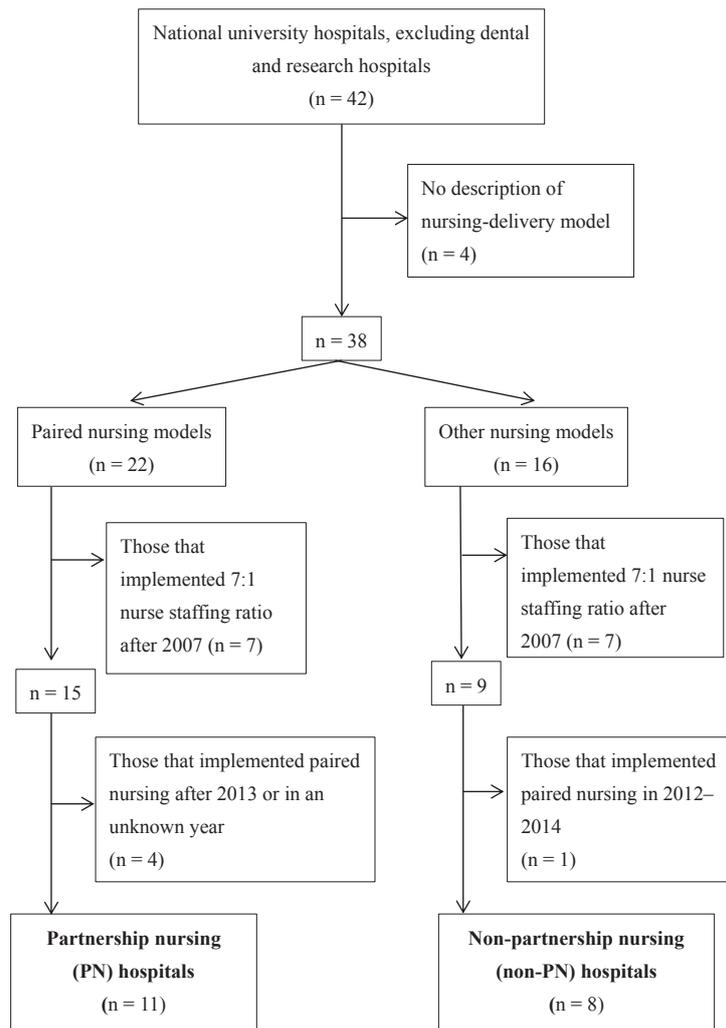
Fig.1 **Flowchart of the hospital-selection process for this study**

Non-PN hospitals: national university hospitals that implemented the 1:7 nurse-to-patient ratio in 2007 and had adopted a non-PN model throughout study periods of 2007–2014.

Data Collection

To create a database, we collected publicly available information concerning each selected hospital's nursing delivery model, the nurse-to-patient ratio being used, accreditation of healthcare quality, in-patient characteristics, and patient outcomes at time of discharge.

We identified each hospital's nursing delivery model by consulting the hospital's official website and/or information pamphlets or other literature provided directly by the hospital. The year in which each hospital had adopted the 1:7 nurse-to-patient ratio was then obtained, either from the hospital's website or the university's performance-evaluation report[11], disclosed on the website of Japan's Ministry of Education, Culture, Sports, Science and Technology. Further, information concerning each hospital's accreditation status from the Japanese Council for Quality Health Care was obtained from the council's official website[12] and/or the hospital's website.

Next, information relating to each hospital's in-patients was extracted from the Diagnostic Procedure Combination (DPC) database, a Japanese administrative-claims system for acute hospital in-patients that was introduced in 2003 by the Ministry of Health, Labour and Welfare[13]. All 42 hospitals included have been participating in the DPC system since its inception; in addition, portions of DPC data from the 2006 to 2014 fiscal years are available to the public through the Ministry of Health, Labour and Welfare website[14]. Consequently, the following information was extracted from the DPC for each hospital: hospital name, number of beds, median length of hospital stay, proportion of patients that

underwent a procedure/received treatment (e.g., surgery, general anesthesia, chemotherapy, radiotherapy), proportion of patients admitted by ambulance, proportion of major diagnostic categories, and clinical outcomes at discharge (including in-hospital mortality). All data utilized were six-month data (July-December), except for 12-month data for 2013 and 2014 relating to patients admitted by ambulance and the procedures/treatments patients underwent/received, as six-month data were not available for these topics. DPC data excluded patients with a length of stay of $\leqq 1$ day, aged <0 years or $\geqq 120$ years, who died $\leqq 24$ hours after admission or $\leqq 7$ days after birth, who underwent a transplant operation or clinical trial, who only received treatment(s) not covered by national health insurance, cases for which there were mistakes relating to the date of admission/discharge or the date of birth, instances of duplicate reports, and cases where the patient was transferred to/from a non-DPC ward, such as a palliative care or rehabilitation ward.

Statistical Analysis

The unit of analysis used was university hospitals, and categorical variables were presented using frequency and percentage. Continuous variables were expressed as median and first- and third-interquartile range, and were compared by years or PN/non-PN hospitals using median values. Further, trends in in-hospital mortality were assessed using two-tailed linear regression models for which $p<0.05$ was considered to represent statistical significance. All statistical analyses were performed using SPSS Statistics 19 (IBM Corp, Armonk, NY).

Ethical Considerations

All of the information used was publicly available; thus, the Ethics Committee of University of the Ryukyus for Medical and Health Research involving Human Subjects approved that the study did not fall under the requirement for ethical review.

RESULTS

The characteristics of all 42 national university hospitals—11 PN hospitals and eight non-PN hospitals— are shown in Table 1. None of the hospitals

Table 1 **Characteristics of the hospitals**

Variables	National university hospitals (n=42)	Hospitals included for analyses (n=19)	PN (n=11)	Non-PN (n=8)
Number of beds, n (%)				
500–699	25 (59.5)	12 (63.2)	6 (54.5)	6 (75.0)
700–899	11 (26.2)	3 (15.8)	2 (18.2)	1 (12.5)
900 and above	6 (14.3)	4 (21.1)	3 (27.3)	1 (12.5)
Location, n (%)				
Metropolitan area	14 (33.3)	5 (26.3)	4 (36.4)	1 (12.5)
Year 1:7 nurse-to-patient ratio was implemented, n (%)				
2007	27 (64.3)	19 (100)	11 (100)	8 (100)
2008	9 (21.4)			
2009	3 (7.1)			
2010–2013	3 (7.1)			
Nursing model, n (%)				
Partnership nursing †	22 (52.4)	11 (57.9)	11 (100)	0 (0.0)
Fixed-team nursing	10 (23.8)	7 (36.8)	0 (0.0)	7 (87.5)
Team nursing	1 (2.4)	0 (0.0)	0 (0.0)	0 (0.0)
Primary nursing	1 (2.4)	0 (0.0)	0 (0.0)	0 (0.0)
Total-care nursing	1 (2.4)	0 (0.0)	0 (0.0)	0 (0.0)
Two or more models other than partnership nursing	3 (7.1)	1 (5.3)	0 (0.0)	1 (12.5)
Unknown	4 (9.5)	0 (0.0)	0 (0.0)	0 (0.0)
JQ accredited 2006–2014, n (%)	28 (66.7)	11 (57.9)	5 (45.5)	6 (75.0)

† "Partnership nursing" includes PNS (Partnership Nursing System) and KIND (Kanazawa University Hospital Interactive Nursing Development); JQ: Japan Council for Quality Health Care

(PN and non-PN hospitals) adopted the partnership nursing model between 2006 and 2010. For the 11 PN hospitals, five had implemented the PN model in 2011, nine by 2012, and all 11 by 2013 and 2014. For non-PN hospitals, the median proportion of patients admitted by ambulance was slightly higher than that of PN-hospitals (8.3% vs. 5.7% in 2014); however, the median length of stay and the proportion of patients receiving general anesthesia or undergoing surgery, chemotherapy, or radiotherapy were similar for both hospital groups (Fig. 2). The most common major

diagnosis throughout the study period was disease(s) of the digestive system (Table 2).

Between 2006 and 2010, the median in-hospital mortality of PN hospitals was lower than that of non-PN hospitals, but in 2011 it was higher (Fig. 3); specifically, the median mortality of PN hospitals showed a decline between 2007 and 2008, an increase from 2009−2011, and then another decline from 2012−2014, though still remaining greater than non-PN hospitals from 2011 through 2014. The non-PN hospitals showed a consistent
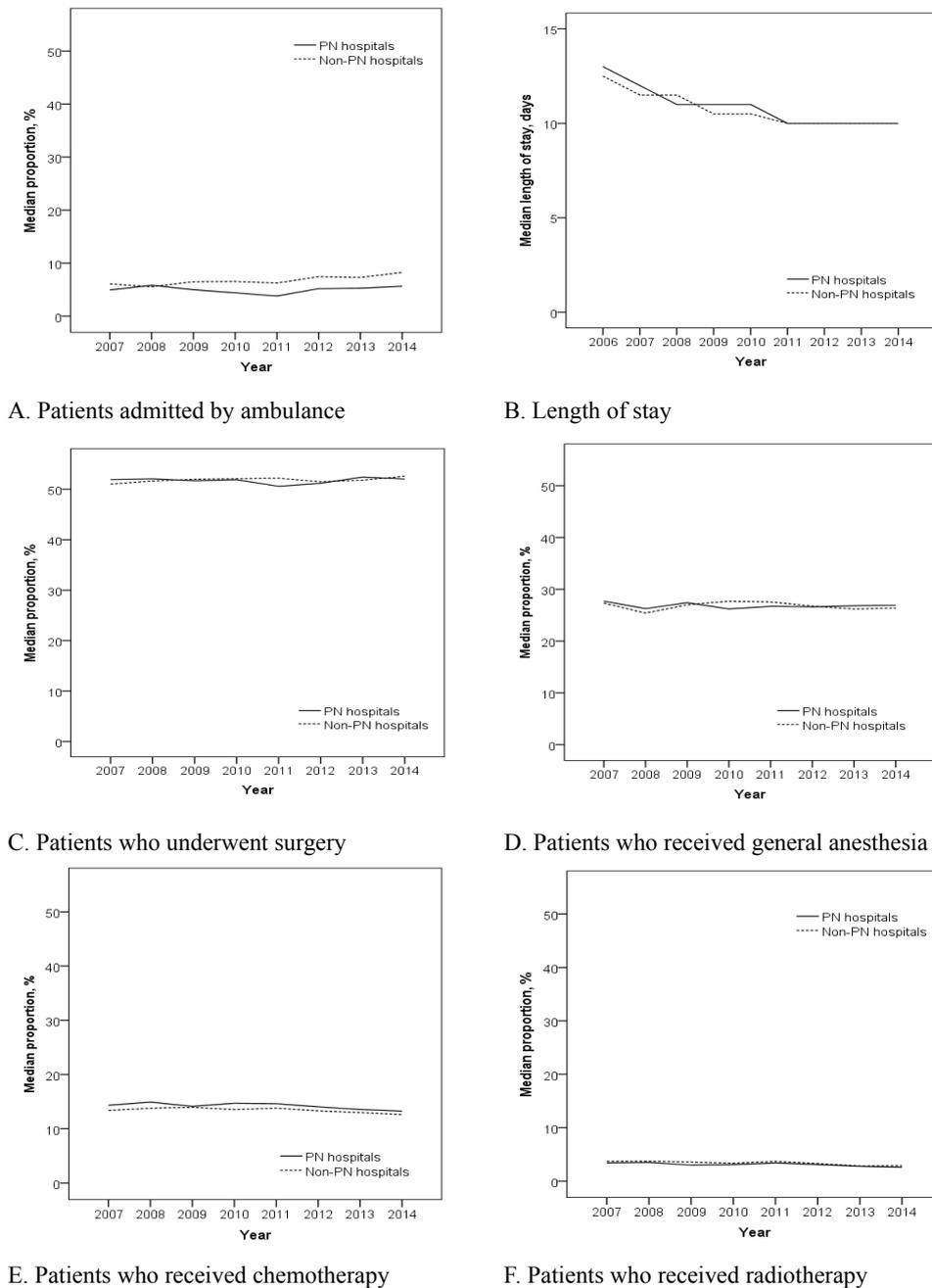

A. Patients admitted by ambulance

B. Length of stay

C. Patients who underwent surgery

D. Patients who received general anesthesia

E. Patients who received chemotherapy

F. Patients who received radiotherapy

Fig. 2 **Comparisons of patients' characteristics between PN and non-PN hospitals**

Table 2 **Median proportion of major diagnostic categories of the partnership nursing (PN) and non-PN hospitals**

| Major Diagnostic Categories	PN hospitals (n=11)									Non-PN hospitals (n=8)								
	2006	2007	2008	2009	2010	2011	2012	2013	2014	2006	2007	2008	2009	2010	2011	2012	2013	2014
Median																		
Digestive	17.0	17.0	19.3	19.3	19.2	19.0	18.3	18.8	19.1	16.4	16.9	18.0	17.4	16.7	17.1	16.5	16.1	16.1
Female reproductive	9.6	9.7	9.5	9.2	8.7	8.6	8.7	8.8	8.3	8.1	8.5	8.3	8.0	7.4	8.6	8.4	9.0	9.1
Musculoskeletal	8.8	9.1	9.8	9.2	7.4	7.2	6.8	7.8	6.9	8.9	8.4	9.6	9.3	7.8	7.5	7.4	7.4	7.1
Circulatory	8.8	9.3	9.0	8.9	8.5	8.6	8.8	8.8	8.6	8.7	9.3	9.2	9.0	8.9	9.7	10.1	10.7	10.5
Eye	8.3	8.6	8.5	9.3	8.8	8.6	8.3	9.2	9.1	9.2	9.5	9.6	8.4	8.6	8.9	8.9	8.8	9.9
Respiratory	7.8	8.4	7.9	8.4	8.5	9.0	8.8	8.6	8.3	6.8	7.1	6.7	6.5	6.8	7.3	7.7	7.5	7.5
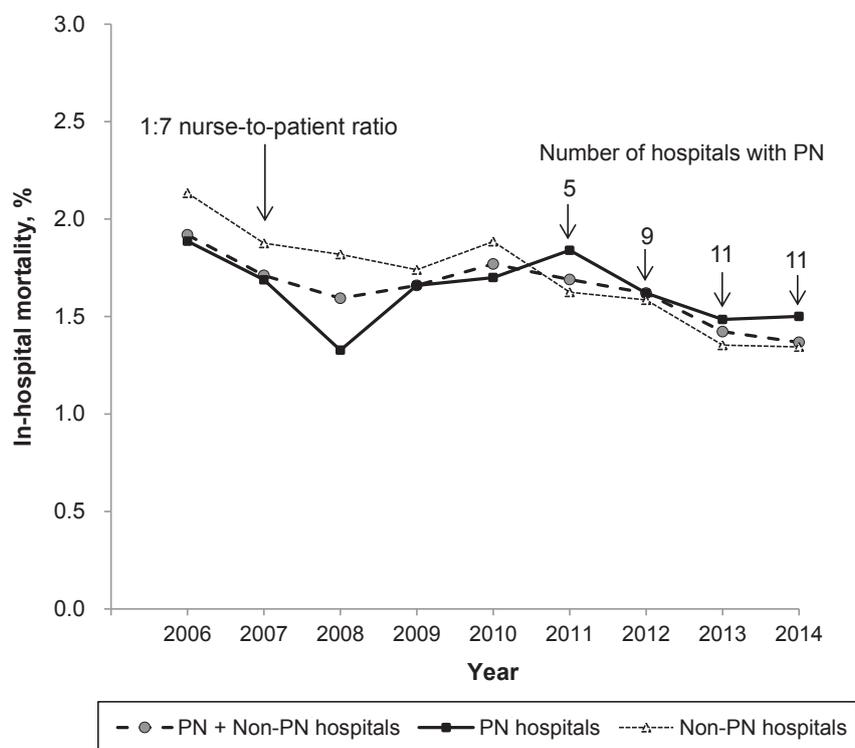
Fig.3 **Median in-hospital mortality of PN hospitals and non-PN hospitals**
A total of 19 hospitals (11 PN hospitals and 8 non-PN hospitals) were included for the analysis. All the PN hospitals and non-PN hospitals adopted 1:7 nurse-to-patient ratio in 2007. For the 11 PN hospitals in the overall sample, five had implemented the partnership nursing model by 2011, nine by 2012, and all 11 by 2013/2014.

decline in their median mortality throughout the study period, except during 2010. Overall, a total of 19 hospitals and non-PN hospitals exhibited a statistically significant declining trend in the in-hospital mortality ($p=0.001$; $p=0.004$), but the trend for PN hospitals was not significant ($p=0.05$).

Further, the linear trend in in-hospital mortality was not statistically significant for either the PN hospitals ($p=0.998$) or the non-PN hospitals ($p=0.23$) for the periods 2006−2010 or 2011−2014 ($p=0.12$ and $p=0.23$, respectively).

DISCUSSION

PN models have been gaining popularity. When we searched hospitals for their nursing delivery models in January 2017, 22 of the 42 national university hospitals (52.4%) had employed a PN model. We selected hospitals with similar characteristics (i.e., national university hospitals) and with the same nurse-to-patient ratio to eliminate the influence of hospital characteristics and nurse staffing on results. However, PN hospitals did not show a declining trend similar to that of non-PN hospitals and showed an increase in median mortality from 2009 to 2011. The reasons for this differing trend remain unclear, as this increase cannot be explained by changes in the proportion of patients admitted by ambulance or the adoption of certain treatment procedures. One possible explanation for this finding relates to differences in the experience of nurses in PN and non-PN hospitals; for example, in two of the PN hospitals examined, the proportion of nurses with fewer than three years of experience was greater than 50%[15, 16]. This percentage is much higher than the average of the 42 national university hospitals, which was between 28% and 35.5% from FY 2007 to FY 2013[3]. This is also supported by data from a survey of head nurses[17], which revealed that the most common reasons for hospitals or hospital wards to implement PN models were to improve the on-the-job training for new graduate nurses (83.2%), to deliver safe and comfortable nursing care (73.1%), and to ease the stress nurses feel when they are solely responsible for the care of a patient (71.2%), showing that the education of inexperienced nurses is emphasized in such institutions.

The median mortality rate of PN hospitals declined after 2011, when the hospitals began to implement the PN models. This finding appears to indicate the beneficial effect of such models on patient mortality, which might be attributed to the following. First, having two nurses observe and assess a patient could have increased the likelihood that they would detect patient deterioration earlier, particularly in cases where one of the nurses in the pair is less experienced. Second, nurses' work environment is a known associated factor of patient mortality[7], and might have contributed to the observed reduction in mortality. This accords with a study by Kamijo et al.,[18] who noted that nurses reported significant reductions in perceived workload and anxiety as well as significant increases in support from colleagues and job satisfaction after implementation of the Partnership Nursing System®. However, similar trend of decline in the in-hospital mortality after 2011 was observed for not only PN hospitals but also non-PN hospitals. Consequently, the decline in mortality in PN hospitals in this period could be attributed to a) the revision of the requirement for 1:7 nurse-to-patient ratio hospitals, which shortened the length of hospital stay and b) an increase in reimbursement for home health services including end-of-life care in 2012[19]. This change facilitated earlier discharge of patients from university hospitals to other medical facilities or patient homes, which could result in a decline in the in-hospital mortality in both PN and non-PN hospitals.

Our findings show an initial decline in in-hospital mortality in both PN and non-PN hospitals following the implementation of the 1:7 nurse-to-patient ratio in 2007, which replaced the 1:10 ratio. Causal relationships could not be derived between nurse staffing and patient mortality from previous cross-sectional studies in the United States[5], nine European countries[6], and South Korea[7]. However, if we apply the findings from these studies, this change in nurse-to-patient ratio from 1:10 to 1:7 potentially accounts for a 15−21% reduction in likelihood of patients dying during hospitalization. Therefore, the initial decline in mortality in our study might be explained by this improvement in the nurse-to-patient ratio.

Limitations

Because the unit of analysis used was university hospitals, it is possible that differences observed between PN hospitals and non-PN hospitals in regard to in-hospital mortality could relate to a difference in hospital characteristics (excluding the nursing model used). While the use of age-adjusted mortality is recommended when comparing between groups, we relied on the crude (unadjusted) mortality rate. We were also unable to adjust for other important covariates of patient mortality, such as patients' severity of disease and co-morbidities, and the experience and educational level of nurses. Finally, because the periods of implementation of partnership nursing models by all 11 PN hospitals were only 2013 and 2014, this study did not precisely

compare hospitals adopting PN models and other nursing delivery models.

CONCLUSION

PN hospitals and non-PN hospitals showed differing trends in in-hospital mortality; thus, we recommend that future studies be conducted to further examine the influence of the 1:7 nurse-to-patient ratio and PN models on in-hospital mortality.

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DISCLOSURE

The authors declare no conflict of interest related to this study.

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