Effects of Nurse Staffing Ratios on Patient Mortality in Taiwan Acute Care Hospitals: A Longitudinal Study

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Introduction

Nursing care is a comprehensive practice that is designed to restore the health of those who are sick and educate individuals to help maintain or improve health (International Council of Nurses, 1973). As such, measuring nursing care quality has become increasingly important. Some studies have placed a growing emphasis on the relationship between nursing care and patient outcomes (Aiken, Clarke, & Sloane, 2001; Aiken, Clarke, Sloane, Sochalski, & Silber, 2002), which involves assessing a patient’s health status or behavior after receiving treatments or nursing care.

Research on nursing care quality typically only evaluated whether nurses completed nursing care plans and followed physicians’ orders until a 1960 study showed that nursing care quality declines with increasing patient numbers (Safford & Schlotfeldt, 1960). Subsequent studies continued to show a significant relationship between nurse staffing ratios and patient outcomes (Aiken et al., 2002; Virtanen et al., 2008; Yang, 2003).

Previous research showed that a 1:4 nurse-to-patient ratio increased the risk of death by 7% for patients within 30 days of hospitalization. This rose to 14% for a 1:6 ratio and 31% for a 1:8 ratio (Aiken et al., 2002). This result suggests that a heavy nurse workload contributes to preventable patient deaths. The chronic shortage of nurses further exacerbates these problems with higher rates of adverse events including medical errors, readmissions, infection, mortality, patient falls, pressure sores, and complaints from patients and their families (Parish, 2002; Unruh, 2003; Yang, 2003).

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ABSTRACT

Background: The nurse workload in Taiwan averages two to seven times more than that in the United States and other developed countries. Previous studies have indicated heavy nursing workload as an underlying cause of preventable patient death. No studies have yet explored the relationship between nurse staffing ratio and patient mortality in Taiwan.

Purpose: This study explored the effect of nurse staffing ratios on patient mortality in acute care hospitals in Taiwan and considered the implications in terms of policy.

Methods: Using stratified random sampling, 108 hospital nursing units in 32 of Taiwan’s 441 accredited Western medicine district/regional hospitals and medical centers were included in the study. Variables were retrospectively measured from 108 wards by using monthly data during a 7-month period. A generalized estimating equation logistic model was used to obtain more precise estimates of the nurse staffing effect by controlling for hospital characteristic and patient acuity variables.

Results: The population-averaged odds ratio for the incidence of death between the low and high patient–nurse ratio groups was 3.617 (95% CI = [1.930, 6.776]). The risk of death in the high patient–nurse ratio group was significantly higher than in the low patient–nurse ratio group.

Conclusions: Nurse staffing levels affect patient outcomes. Faced with the problem of inadequate nurses for hospital healthcare needs, Taiwanese policymakers should work to implement a legislatively mandated minimum patient–nurse ratio on a shift-by-shift basis to regulate nurse staffing. In setting guidelines for nurse staffing, policymakers must consider nursing staff characteristics in addition to the number of nurses.

Key Words: nurse staffing ratio, patient mortality, generalized estimating equation (GEE).

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Studies have also found that the incidence of patient complications in an intensive care unit are related to the number of nurses, with a larger number of experienced nurses resulting in fewer medication errors and patient fall incidents (Blegen et al., 2004; Pronovost et al., 2001). These results show that nurse staffing adequacy and composition directly affect patient outcomes.

Taiwan has operated a universal, comprehensive National Health Insurance (NHI) program since 1995. Because of serious financial difficulties, NHI enacted a hospital global budget payment system in 2002 to control healthcare expenses. This change in hospital reimbursements requires that hospitals adopt various measures to increase overall net revenues. Common strategies used by hospitals to reduce expenses included reducing nursing staff by not hiring new staff members to fill existing or potential vacancies and making greater use of contract and part-time employees. The hospital global budget affected the employment of nurses responsible for providing direct patient care (Liu, 2005). This may have a negative effect on quality of patient care.

A 2011 survey of nurse workload found that each nurse in Taiwan cares for an average of 8 to 11 patients on daytime shifts and 20 to 30 patients on night and early-morning shifts (Central News Agency, 2011). This workload is two to seven times greater than nurses in the United States and other developed countries (Liang et al., 2010). In addition to providing direct patient care, nurses in Taiwan have many administrative and general responsibilities and frequently work overtime (Sun, Lin, Kao, Change, & Shaw, 2005). Heavy workload, low pay, and excessive pressure are root causes of Taiwan’s high nurse turnover rates (Central News Agency, 2011). This vicious cycle may weaken the healthcare system and its ability to react in a timely fashion to community health needs. Previous studies on the Taiwan nurse workforce focused mainly on nurse mobility, factors related to nurses’ intention to leave, and nursing supply and demand (Chen et al., 1990; Lan et al., 1991); few studies have explored the relationship between nurse staffing ratios and patient mortality.

Although many studies in western countries have explored the effects of nurse staffing ratios on patient outcomes, results cannot be applied directly to Taiwan because of different contexts. This study explores the effect of nurse staffing ratios on patient mortality in acute care settings and considers its relevance for policy.

**Methods**

This study used a health production function input–output model to explore the effects of nurse staffing ratio on patient mortality. Input production factors included labor inputs (such as nursing workforce and physician workforce) and capital inputs (such as medical equipment and beds). Patient outcome was the output (defined as whether a patient death occurred). Study data were collected as longitudinal data (time series and cross-sectional), with characteristics and corresponding care outcomes for the same hospitals and wards observed during a consecutive 7-month period to allow correlation of data measured from the same ward. Data analysis in the absence of longitudinal data correlations would bias estimation work and potentially generate incorrect conclusions.

To deal with longitudinal data correlation, Liang and Zeger (1986) proposed generalized estimating equations (GEEs); GEEs extend generalized linear models into a regression setting with correlated observations within subjects. The major advantages of GEEs are as follows: (a) they refer to a population-averaged (marginal) model so that full specification of population distribution is not necessary for the estimation process and (b) they are able to obtain a consistent estimator even when the longitudinal data correlation structure is mistakenly specified (Hardin & Hilbe, 2003). GEE identifies the correlation structure in the working correlation matrix to specify possible longitudinal data correlations. Hardin and Hilbe (2003) proposed the quasi-likelihood under the independence model criterion (QIC) measure to choose among competing correlation structures, for example, independent, exchangeable, autoregressive, and unstructured. Smaller QIC values indicate better model specification fit.

The binary output variable of this study (1 = one or more deaths; 0 = no death) recommended our adopting a GEE logistic model (GEE with logit link function) to analyze the effects of nurse staffing ratio on patient mortality. We used SPSS 17.0 (IBM, Armonk, NY, USA) to complete the GEE logistic model estimation.

**Data Sources and Variable Definitions**

Study data originated from a survey on hospital nurse staffing levels and patient outcomes conducted in 2008 to 2009. The unit of analysis was the hospital ward, which maintained anonymity of the patient information. The original study population comprised internal medical wards, surgical wards, comprehensive wards, and intensive care units at 441 accredited Western-medicine hospitals at the end of 2006 in Taiwan, among 556 Western-medicine hospitals (88 public hospitals and 468 private hospitals, among which 20 were medical centers, 74 were regional hospitals, and 347 were district hospitals). The researchers adopted a stratified random sampling method based on the proportion of three types of hospitals: medical centers (4.5%), regional hospitals (16.8%), and district hospitals (78.7%). A total of 32 hospitals and 108 wards were sampled as data sources for this study. Data were collected from the 108 wards between July 2008 and January 2009. As total death counts for each hospital ward were not available to researchers, the dependent variable in this study was set as the binary variable of patient outcome. When a death in ward i at time t was observed, the incidence of death was coded as 1 and other conditions as 0. Independent variables included labor inputs (such as patient–nurse ratio and healthcare workforce–bed ratio), capital inputs (technological equipment–bed ratio),
and control variables (severity of disease). Labor input variables included two dummy variables to distinguish different workforce inputs. The first dummy variable was defined using average patient–nurse ratio as the cut-off point, and study participants were differentiated into two groups of high patient–nurse ratio (coded as 1) and low patient–nurse ratio (coded as 0). The second dummy variable was defined using the average healthcare workforce–bed ratio (total number of nurses and physicians divided by total number of beds) as the cut-off point, and study participants were differentiated into two groups of high healthcare workforce–bed ratio (coded as 1) and low healthcare workforce–bed ratio (coded as 0). Capital input variables used three dummy variables to distinguish different hospital capital inputs. The first used the average technological equipment–bed ratio as the cut-off point and differentiated study participants into one of two groups: high technological equipment–bed ratio (coded as 1) and low technological equipment–bed ratio (coded as 0). Technological equipment included facilities such as magnetic resonance imaging, computed tomography, 64-multislice positron emission tomography, gamma knife, photon knife, electronic nursing trolley, electronic nursing care plan, computerized reporting system for abnormal hospital events, and computerized patient prescription systems. We used two dummy variables to distinguish among the three different hospital types (medical center, regional hospital, and district hospital). Medical centers are typically the largest in scale with the most capital inputs; regional hospitals are typically of intermediate scale and capital input; and district hospitals typically have the smallest scale and least capital input.

Age and ward type were used to measure disease severity. Age has been previously indicated as a proxy for illness severity (Warwick & Frank, 1998). Wards with patient ages averaging 65 years and above were coded as 1, and those with average patient ages below 65 were coded as 0. Because patients in intensive care units typically have a higher severity of disease than those in the internal medicine, surgical, and comprehensive wards, three dummy variables were used to distinguish among the four different ward types (internal medicine ward, surgical ward, comprehensive ward, and intensive care unit) in order to differentiate among various average disease severity levels.

Hospitals approved the study protocol and consent forms prior to study implementation. Head nurses in the target wards collected data on a monthly basis. Hospital authorities and research term members reviewed completed questionnaires to ensure data were recorded correctly.

### Results

Descriptive statistics for all variables are summarized in Table 1. During the observation period, 68% of hospital wards reported patient deaths. The average patient age was approximately 60 years, and about 33% of observations pertained to the older population group, with an average age of 65 years and above. The average patient–nurse ratio was approximately 9, and 62% of sample observations were in the high patient–nurse ratio group (patient–nurse ratio above average). In this sample, about 34% of observations were collected from internal medicine wards, 25% from surgical wards, 12% from comprehensive wards, and 29% from intensive care units. Moreover, about 11% of observations were from medical centers, 58% from regional hospitals, and 31% from district hospitals. The average technological equipment–bed ratio was 0.85 (per 100 beds), and about 29% of the values pertained to a high equipment–bed ratio group (equipment–bed ratio above average). Finally, the average healthcare workforce–bed ratio was 0.84, and about 47% of observations pertained to the high healthcare workforce–bed ratio group (healthcare workforce–bed ratio above average).

### Table 1. Descriptive Statistics

<table>
<thead>
<tr>
<th>Variable</th>
<th>M</th>
<th>SD</th>
<th>Sample Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Occurrence of death</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Y = 1 (if death case is observed)</td>
<td>517</td>
<td>68</td>
<td></td>
</tr>
<tr>
<td>Y = 0 (if otherwise)</td>
<td>239</td>
<td>32</td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>59.77</td>
<td>9.29</td>
<td></td>
</tr>
<tr>
<td>&gt;65 years (TG)</td>
<td>250</td>
<td>33</td>
<td></td>
</tr>
<tr>
<td>≤65 years (RG)</td>
<td>506</td>
<td>67</td>
<td></td>
</tr>
<tr>
<td>Patient–nurse ratio</td>
<td>9.23</td>
<td>5.17</td>
<td></td>
</tr>
<tr>
<td>&gt;Mean (TG)</td>
<td>469</td>
<td>62</td>
<td></td>
</tr>
<tr>
<td>≤Mean (RG)</td>
<td>287</td>
<td>38</td>
<td></td>
</tr>
<tr>
<td>Type of ward</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Internal medicine ward (TG)</td>
<td>259</td>
<td>34</td>
<td></td>
</tr>
<tr>
<td>Surgical ward (TG)</td>
<td>189</td>
<td>25</td>
<td></td>
</tr>
<tr>
<td>Comprehensive ward (TG)</td>
<td>91</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>Intensive care unit (RG)</td>
<td>217</td>
<td>29</td>
<td></td>
</tr>
<tr>
<td>Type of hospital</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Medical center (TG)</td>
<td>84</td>
<td>11</td>
<td></td>
</tr>
<tr>
<td>Regional hospital (TG)</td>
<td>441</td>
<td>58</td>
<td></td>
</tr>
<tr>
<td>District hospital (RG)</td>
<td>231</td>
<td>31</td>
<td></td>
</tr>
<tr>
<td>Technological equipment–bed ratio</td>
<td>0.85</td>
<td>0.69</td>
<td></td>
</tr>
<tr>
<td>&gt;Mean (TG)</td>
<td>222</td>
<td>29</td>
<td></td>
</tr>
<tr>
<td>≤Mean (RG)</td>
<td>534</td>
<td>71</td>
<td></td>
</tr>
<tr>
<td>Healthcare workforce–bed ratio</td>
<td>0.84</td>
<td>0.29</td>
<td></td>
</tr>
<tr>
<td>&gt;Mean (TG)</td>
<td>352</td>
<td>47</td>
<td></td>
</tr>
<tr>
<td>≤Mean (RG)</td>
<td>404</td>
<td>53</td>
<td></td>
</tr>
</tbody>
</table>

*Note. TG = target group; RG = reference group.*

*Technological equipment includes facilities such as magnetic resonance imaging, computed tomography, 64-multislice positron emission tomography, gamma knife, photon knife, electronic nursing trolley, electronic nursing care plan, computerized reporting system for abnormal events, and computerized patient prescription system.*
Table 2 lists empirical results of the GEE logistic model with an independent structure in the working correlation matrix. The researchers chose an independent structure, because the independent structure QIC scored 718.38, which was less than QICs with other competing correlation structures for the working correlation matrix (exchangeable QIC = 721.46, autoregressive QIC = 718.76, and unstructured QIC = 726.77). It should be noted that the GEE logistic model is a nonlinear population-averaged model. The impact of independent variables on a dependent variable could not be directly estimated from estimated coefficients. Therefore, the natural exponential value of the estimated coefficient was used to obtain the population-averaged odds ratio (OR; defined by a ratio of two odds) for the incidence of death between average target group (see Table 1) and average reference group (see Table 1).

Labor input and patient mortality results conformed to expectations. The estimated coefficient for the patient–nurse ratio was statistically positive at a 1% significance level. The population-averaged OR for the incidence of death between the low and the high patient–nurse ratio groups was 3.617 (95% CI = [1.930, 6.776]). This result indicated the risk of incidence of death in high patient–nurse ratio groups was 3.617 (95% CI = [1.930, 6.776]). This result shows the risk of incidence of death in high patient–nurse ratio groups than in low patient–nurse ratio groups as much lower than in low healthcare workforce–bed ratio groups.

In addition, the estimated coefficient of age was statistically positive at 1% significance. The population-averaged OR for the incidence of death between the age 65 or above and its counterpart was 2.727 (95% CI = [1.653, 4.498]). This result showed the risk of incidence of death in the group averaging 65 years and up was much higher than in the younger age group. Estimated coefficients for internal medicine wards, surgical wards, and comprehensive wards were statistically negative at a 1% significance level, with corresponding population-averaged OR for the incidence of death scoring 0.083 (95% CI = [0.038, 0.178]), 0.011 (95% CI = [0.005, 0.026]), and 0.102 (95% CI = [0.041, 0.255]), respectively. These results indicated that the risk of incidence of death in intensive care units was higher than in internal medicine wards, surgical wards, and comprehensive wards.

Finally, only the estimated coefficient of regional hospitals attained statistical significance (at the 1% level). The population-averaged OR for incidence of death between regional hospitals and district hospitals was 2.080 (95% CI = [1.284, 3.731]). This result indicates that the risk of incidence of death in regional hospitals was much higher than in district hospitals.

Table 1

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Wald χ²</th>
<th>Odds Ratio</th>
<th>95% CI for Odds Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patient–nurse ratio dummy (&gt;mean)</td>
<td>1.286</td>
<td>16.10**</td>
<td>3.617</td>
<td>[1.930, 6.776]</td>
</tr>
<tr>
<td>Age dummy (≥65 years)</td>
<td>1.003</td>
<td>15.44**</td>
<td>2.727</td>
<td>[1.653, 4.498]</td>
</tr>
<tr>
<td>Internal medicine ward</td>
<td>-2.493</td>
<td>40.33**</td>
<td>0.083</td>
<td>[0.038, 0.178]</td>
</tr>
<tr>
<td>Surgical ward</td>
<td>-4.482</td>
<td>106.69**</td>
<td>0.011</td>
<td>[0.005, 0.026]</td>
</tr>
<tr>
<td>Comprehensive ward</td>
<td>-2.281</td>
<td>23.84**</td>
<td>0.102</td>
<td>[0.041, 0.255]</td>
</tr>
<tr>
<td>Medical center</td>
<td>0.419</td>
<td>1.25</td>
<td>1.520</td>
<td>[0.730, 3.163]</td>
</tr>
<tr>
<td>Regional hospital</td>
<td>0.732</td>
<td>8.85**</td>
<td>2.080</td>
<td>[1.284, 3.731]</td>
</tr>
<tr>
<td>Healthcare workforce–bed ratio dummy (&gt;mean)</td>
<td>-0.556</td>
<td>6.26*</td>
<td>0.573</td>
<td>[0.371, 0.886]</td>
</tr>
<tr>
<td>Technological equipment–bed ratio dummy (&gt;mean)</td>
<td>0.192</td>
<td>0.66</td>
<td>1.212</td>
<td>[0.762, 1.928]</td>
</tr>
<tr>
<td>Constant</td>
<td>1.973</td>
<td>35.36**</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: QIC with independent structure equals 718.38, which is less than these QICs with other correlation structures for the working correlation matrix (such as exchangeable QIC = 721.46, autoregressive QIC = 718.76, and unstructured QIC = 726.77).

*p<.05.  **p<.01.

Discussion

The review of literature on the relationship between nurse staffing and patient outcomes found that most studies were conducted at the hospital level and aggregated across all nursing units. However, nurse staffing varies among hospital units. The many factors that affect nurse staffing include the type of patient admissions, acuity of patient conditions, and intensity of care (Needleman, Buerhaus, Mattke, Stewart, & Zelevinsky, 2001). For this study, analyses focused on data collected from wards, which provided more accurate information regarding actual patient experiences in specific nursing units.

Nurses are an essential component of the healthcare delivery system, and nursing is a patient-centered profession. Therefore, the adequacy of nurse staffing is closely related to success achieved in monitoring patient conditions. The risk of incidence of death in high patient–nurse ratio wards was found to be much higher than in low patient–nurse ratio wards.
wards (population-averaged OR = 3.617, 95% CI = [1.930, 6.776]) after extensive multivariate adjustment for patient and hospital characteristics. This result echoes the findings of previous studies (Aiken et al., 2002; Rafferty et al., 2006). The findings of this study cannot be compared directly with the results of the study of Aiken et al. because the unit of analysis differs among studies. Whereas the risk of death generated by Aiken and colleagues was based on representative patient-level data, this study estimated the risk of death based on a representative hospital-ward-level data. Ecological fallacy would result from attempting to derive conclusions from a direct comparison of risk measures between the two. Nevertheless, as noted in Table 1, nurses in Taiwan care for approximately nine patients on average. This reduces the time nurses are able to spend caring for each patient and increases the risk of patient death. Nurses are a critical component of the surveillance system for early detection of problems in patient care. They are also in the best position to initiate actions to achieve desired patient outcomes (Clarke & Aiken, 2003). The primary conclusion of this study is that there are detectable differences in risk-adjusted mortality rates across hospitals with different nurse staffing ratios.

Study results imply that a legislatively mandated minimum patient–nurse ratio as implemented in Victoria (Australia), California (United States), and Europe should have a positive impact on patient safety. This approach is nevertheless opposed by the American Nurses Association, which argues that such ratios might become staff “ceilings” rather than minimums and could be addressed using personnel with inappropriate skill mixes (American Nurses Association, 1999).

Appropriate patient–nurse ratios cannot be specified by unit or shift because many factors affect these ratios such as disease severity and characteristics, patient numbers, hospital level and technological sophistication, nurse professional knowledge, and nurse staff mix. Nevertheless, these study results highlight a need for policymakers to establish a mandated maximum patient–nurse or minimum nurse–patient ratio.

The population-averaged OR in patient–nurse ratios probably underestimate the true situation, because the actual number of patients cared for by one nurse in Taiwan may be greater than statistically reported (Kao, 2008). Therefore, it is expected that avoidable deaths could be reduced if the patient–nurse ratio is kept below 9:1. In addition, the population-averaged OR of the healthcare workforce–bed ratio was 0.573 (95% CI = [0.371, 0.886]). This means that the probability of death in wards with a high healthcare workforce–bed ratio is less than that in wards with a low healthcare workforce–bed ratio. One weakness of previous work in the field is the frequent omission of data on physicians. Jarman found physicians to be the most important professional group associated with reduced mortality (Jarman et al., 1999). However, only a few North American studies looked at physicians specifically, and these found that number of residents/interns (Kovner & Gergen, 1998) and number (Unruh, 2003) or percentage of board-certified subspecialists (Manheim, Feinglass, Shortell, & Hughes, 1992) contributed to variations in patient outcomes. All concurred, however, that the effect of nurse staffing levels significantly exceeded the effect of medical staff. This implies that increasing both nurse staffing levels and overall healthcare workforce can reduce patient mortality. It also implies that current hospital nursing vacancies in Taiwan are much more severe than typically stated. In 2002, Taiwan NHI adopted a “global budgeting” system for hospitals in an attempt to rein in healthcare costs. Hospital administrators reorganized patient care services by cutting services and/or reducing nursing staff (Sun et al., 2005). Therefore, it is more difficult to increase nurse staffing levels, even when RNs are replaced with less costly staff members.

Current patient–nurse ratios for hospitals in Taiwan are based on Hospital Accreditation Standards and Standards for Hospitals requirements. These two standards require hospitals to maintain certain patient–nurse ratios for different types of wards. However, current ratios are inadequate and are inadequately enforced. At some Taiwan hospitals, nurses on night shifts may be assigned 20 to 30 patients or five times the number of patients assigned to their European or U.S. counterparts (Central News Agency, 2011). Patient attendants, nurse aides, and ward clerks were excluded from nurse staffing ratio calculations in this study. However, overall patient–nurse ratios do not reflect differences among shifts. Hospitals may disregard actual patient numbers when determining nurse staffing needs for each shift. Although most hospitals meet accreditation requirements, a 2008 survey found each nurse cares for an average 10, 16, and 22 patients during day, night, and early-morning shifts, respectively (Kao, 2008). These numbers were very close to our nurse staffing data showing surveyed nurses cared for an average of 11, 18, and 20 patients during the same shift periods.

To comply with nurse staffing standards, hospital administrators reduce night and early-morning shift nurse staff numbers and increase numbers of dayshift nurses. Lack of consideration of actual shift workloads means that night and early-morning shift nurses bear excessive patient care loads. To remedy this problem, legislating minimum, specific, and numerical licensed patient–nurse ratios by licensed nurse classification and hospital unit is an urgent priority.

Modifying systems with long histories is always challenging. Decreasing the patient–nurse ratio or increasing the patient–nurse ratio directly affects the hospital and increases expenditures. To minimize this impact, policymakers may adopt a “carrot-and-stick” approach to facilitate nurse staffing adjustments. Although National Health Insurance currently pays the nursing fee of about NTD 492 (USD 16) to NTD 613 (USD 20) per inpatient per day, this covers only half of a hospital’s actual nursing cost (Liang et al., 2010). Hospitals use the insufficient inpatient nursing fee as an excuse to dramatically reduce nurse staffing, exacerbating the nursing shortage and work overload. Furthermore,
a comparison of nursing fees and claim data indicated the nursing fee portion of daily claimed points to be less than 12% (Bureau of National Health Insurance, 2011). The response of hospital administrators to the minimum patient-nurse ratio in light of already tight margins may be to restrict healthcare access, reduce services, and reduce expenditures on new equipment and technologies. These and other similar decisions may adversely affect nursing care quality and patient outcomes. Because legislation generally does not provide funds or mechanisms to help hospitals meet proposed staffing ratios, hospitals may struggle to meet minimum ratio requirements (Conway, Tamara Konetzka, Zhu, Volpp, & Sochalski, 2008).

Although using unit-level data provides a significant advance over previous studies in which only hospital-level data are available, we are aware that many other issues affect the rigor and degree to which studies to date are able to elucidate the true effect of nurse staffing on patient outcome (Sales et al., 2008). First, our binary outcome variable ignores the potential of more than one death in each ward during the study period and may result in underestimating population-averaged ORs obtained using the GEE logistic model. It follows that the positive impact of nurse staffing levels on patient mortality as measured using the patient–nurse ratio should be stronger than indicated in this study. Second, study data from acute internal medical, surgical, comprehensive wards, and intensive care units were considered together, and therefore, caution is advised when generalizing results because of differences in nurse staffing ratios reflecting different patient conditions and different ward characteristics. Third, the healthcare system, content of care, patient needs, and hospital culture should be taken into account when reviewing nurse staffing levels. A singular focus on reducing the patient–nurse ratio cannot change the nature of nursing care as created by the medical culture or solve all inadequate nurse staffing problems. Fourth, this study used the ward as the analysis unit rather than the patient as in most prior studies. This allows more explicit calculation of the effects of the nurse staffing ratio on patient outcomes. Therefore, only percentage of possible adverse events in wards can explain data analysis and interpretation in the current study. Inviting more hospitals to participate and extending the data collection period should increase study generalizability. Whereas results found significant effects, a longer observation period would allow better tracking of changes in the effects of nurse staffing on patient outcomes and facilitate appropriate decision-making.

Conclusions
Although limitations exist in the measures used to study the relationship between nurse staffing ratios and patient outcomes, our findings are consistent with previous studies. Nurse staffing does affect patient outcomes. Factors other than staffing levels such as hospital level and ward type are also important determinants of patient outcomes. Faced with inadequate nurse staffing, Taiwanese policymakers should legislate mandated minimum patient–nurse ratios on a shift-by-shift basis to regulate nurse staffing. In setting guidelines for nurse staffing, policymakers must also consider nursing staff characteristics along with numbers. Finally, hospital administrators should take steps to make working conditions more attractive to encourage nurse entry into the profession and retain current nurses.

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References


台灣急性醫院病房護理人力配置對住院病人死亡率影響之綏貫研究

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背景 台灣護理人員的工作負荷約為美國等其他開發國家護理人員的2－7倍。研究指出，護
理人員工作負荷過重是病人可預防死亡的原因之一，然而，台灣迄今未見護理人力對
病人死亡影響之研究。

目的 採訪台灣急性醫院病房護理人力配置對病人死亡率的影響。

方法 本研究以2006年底健保特約並通過醫院評鑑地區教學醫院層級以上之441家西醫院為研
究母群體，透過分層隨機抽樣，選取32家醫院108個病房，連續收集7個月的資料。在
控制醫院屬性及病人嚴重度後，以廣義估計方程式估計logistic模型，藉以檢視護理人力
配置對病人結果的影響。

結果 高病護比病房相對於低病護比病房，發生死亡事件的母體平均勝算比為3.617（95% CI
= [1.930, 6.776]），意謂著高病護比病房發生死亡事件的風險將高於低病護比病房。

結論 護理人力配置影響病人結果，對護理人力配置不當的困境，政策制定者應建立以班
別為基礎的護理人力配置標準。此外，除考量護理人數外，也應將其他護理人力特性
（如學歷）一併納入考量。

關鍵詞：護理人力配置、病人死亡率、廣義估計方程式。