Relationships Between Nurse Staffing and Patient Outcomes

Ke-Ping Yang

ABSTRACT: Nursing studies have shown that nursing care delivery changes affect staff and organizational outcomes, but the effects on client outcomes have not been studied sufficiently. The purpose of this study was thus to examine the effect of nurse staffing variables- daily average hours of care, ratio of RNs to average patient census, workload, and skill mix- on patient outcomes as measured by five adverse occurrences. The adverse patient occurrences included unit rates of patient falls, pressure ulcers, respiratory and urinary tract infections, and patient/family complaints. Variables were measured retrospectively using consistently available data from each month of fiscal year 2000 from 21 medical-surgical nursing care units in a 1394-bed medical center in Taiwan. Data were analyzed by descriptive and multivariate inferential statistics while controlling for patient acuity level. Results showed that workload of nurses is the most powerful predictor of nosocomial infections and hours of care best predicted the five adverse patient outcome indices. Lower adverse outcome rates were more consistently related to a higher proportion of N3 level of RNs. Patients could fare better when N3s play a significant role in the staffing mix. The findings provide further empirical support for the context of implications that patient outcomes are correlated to organizational structure. It obviously illustrates the relationships between nurse staffing and the quality of nursing practice.

Key Words: nurse staffing, patient outcomes, adverse patient outcome occurrences.

Introduction

The health care arena in Taiwan has witnessed pronounced changes in hospitals since the implementation of National Health Insurance (NHI) in 1995. The changing payment systems resulting from NHI has accelerated the pace of hospitals' restructuring and re-engineering initiatives intended to decrease costs and increase productivity (Yang, 1998). Little is known, however, about how these initiatives have affected the effectiveness and efficiency of clinical care and patient outcomes.

Many Taiwanese hospitals undertook initiatives to reduce their nursing workforce (Yin & Yang, 2002). Nonetheless, nursing professionals typically represent the largest employee group in hospitals, and have become a primary target for redesign measures (Yang, Simms, & Yin, 1999). With the increasing complexity of health care, as well as the work responsibilities of RNs, the need for even more highly trained staff will continue (Yang, 1997). In addition, changes in life style, aging of the population, changes in medical behavior, and the increasing demands and scope of health care all directly or indirectly affected the demand for nursing manpower. This financial decision, a cutback in the nursing workforce, however, has degraded the quality of patient care (Blegen, Goode, & Reed, 1998), and has seriously eroded the safety of patient care (Hodge, 2000).

The American Nurses' Association's (ANA) Safety and Quality Initiative has focused on educating registered nurses (RNs) about quality measurement, informing the public and purchasing/regulating constituencies about safe, quality health care, and investigating research methods and data sources to empirically evaluate the safety and quality of patient care (ANA, 2000a). Principles for nurse staffing tend to be one of these major efforts. Yin and Yang (2002) have found that quality of care is strongly associ-

RN, PhD, President, Cardinal Tien College of Nursing.
Received: February 11, 2003 **Revised:** May 26, 2003 **Accepted:** June 16, 2003
Address correspondence to: Ke-Ping Yang, 364, Chung-Cheng Rd., Hsin-Tien, Taipei 231, Taiwan, ROC.
Tel: 886(2)2219-3590; Fax: 886(2)2219-7718; E-mail: kp@ctcn.edu.tw

ated with appropriate staffing. Nursing staffing not only changes relative to the case mix of patients receiving care, but also to changes in nursing practice environment (Aiken, Clarke, & Sloane, 2000). There is no hiding the fact that nurses today have continuing cause to be concerned about optimal staffing after 40 years (Blegen, Goode, & Reed, 1998).

A recent study conducted by the US Department of Health and Human Services (HHS), Health Resources and Services Administration revealed that strong and consistent relationships were found between hospital nurse staffing levels and five patient outcomes- urinary tract infections, shock, length of stay, upper gastrointestinal bleeding, and pneumonia (HRSA, 2001). McCloskey (1998) found that there is a direct relationship between total hours of care from all nursing personnel and rates of decubiti, complaints, and mortality. Her study further revealed that as the RN proportion of care rose to an 87.5% level, it related to a lower incidence of negative outcomes; however, when the RN proportion of care went beyond that level, the adverse outcome rates also increased. Blegen et al. (1998) also confirmed that the proportion of hours of care delivered by RNs was inversely related to the unit rates of medication errors, decubiti, and patient complaints. Aiken and her colleagues not only found effects of staffing levels and the workplace environment on patient outcomes but also found that they affected staff retention in a five-nation study (Smith, 2002).

As long ago as 1960, Safford and Schlotfeldt's experimental study demonstrated that the quality of nursing care would decrease as the number of patients assigned to nurses increased. However, Aydelotte and Tener (1960) found a decrease in patient complaints when these was an increase in the number of nurses, although patient welfare was not found to be increased. Aiken et al. (2000) further contended that variation in nurse staffing is a major determinant of variation in patient outcomes. Therefore, a key part of resource allocation decisions is determining the impact of staffing on patient outcomes (Minnick & Pabst, 1998).

Although the relationship between patient outcomes and nurses staffing is undoubtedly complex, nurse to patient staffing ratios appear to be consistent predictors of variation in patient outcomes, including complication and error rates (Blegens, Goode, & Reed, 1998; Kovner & Gergen, 1998). Numerous studies extended current knowledge about the relationship between nurse staffing and patient outcomes by using a wider range of patient outcome indicators while controlling for patient acuity levels (ANA, 2000a; Blegen & Vaughn, 1998; Buerhaus & Needleman, 2000; Jackson, Chiarello, Gaynes, & Gerberding, 2002; Murphy, 1993; Reed, Blegen, & Goode, 1998; Saver, 2001; Smith, 2002). It is difficult however, to identify sensitive data that reflect outcomes specifically affected by the quality of nursing care (Jones, 1993). Anderson et al. (1999) addressed the issue that outcomes could reflect either favorable or adverse changes in health status. Both favorable outcomes and adverse patient occurrence data may mislead the merits of attempted evaluation without adjusting for predisposing risks and severity of illness.

Porell, Caro, Silva, and Monane's (1998) study showed that estimated parameters for nursing home resident demographic and diagnostic attributes have a great deal of construct validity with respect to clinical expectations regarding risk factors for adverse outcomes. Risk adjustment is thus an important component of an outcomes study (Anderson et al., 1999). "The goal of risk adjustment is to account for pertinent patient characteristics before making inferences about the effectiveness or quality of care based upon patient outcomes" (Iezzoni, 1997, p. 3). The validity of acuity levels has commonly been used to adjust outcomes of medical care in hospitalized patients (Shortell et al., 1994). Little research, however, has addressed the appropriateness of the adverse outcome indices for risk adjustment in studies of nursing-sensitive patient outcomes (Anderson et al., 1999).

In summary, nursing studies have shown that nursing care delivery changes affect staff and organizational outcomes, but the effects on client outcomes have not been studied sufficiently. In Taiwan, no studies have been reported which take advantage of the nurse staffing utility control offered by the patient classification system in most medical centers. The current study thus explored the following question: "What are the relationships between nurse staffing and adverse patient occurrences while controlling for patient severity?"

Purpose

The purpose of this study was to examine the relationship between hospital nurse staffing and patient outcomes that were sensitive to nursing, while controlling for patient acuity at the level of the nursing care unit. Figure 1 illustrates the conceptual framework and the related variables. Nurse staffing variables included daily average hours of

Conceptual Framework

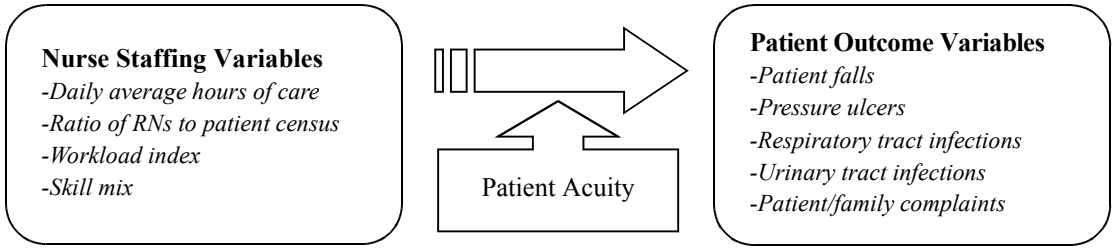

Figure 1. Patient outcome variables are affected by variables related to nurse staffing while controlling for patient acuity levels.

care, ratio of RNs to average patient census, skill mix and workload. Patient outcomes were measured by five adverse occurrences: unit rates of patient falls, pressure ulcers, respiratory and urinary tract infections, and patient/family complaints. Acuity of patients was indicated by weighting scores assigned to five types of patients based on their dependency levels for the unit as a whole. These data were consistently available from the patient classification system in the sample hospital.

Methods

A descriptive correlation study design was used to examine the relationships between nurse staffing and the selected five patient outcome indicators. Data were used from each month of fiscal year (FY) 2000 for nursing care units in a tertiary care medical center in Taiwan with 1394 beds. A cluster sampling of all 21 medical-surgical inpatient units was recruited. Care was provided on these units by 347 total full time equivalent (FTE) RNs. The total number of inpatients in FY 2000 was 29,424, ranging from 771 to 2715 per unit with a mean of 1407.

Measures

All the study data came from hospital statistics that were readily available or easily estimable by head nurses or supervisors of the nursing quality improvement committee (NQIC). Data on the four nurse staffing variables- daily average hours of care, ratio of RNs to average patient census, workload index, and skill mix- were drawn from monthly statistical reports on staffing needs of medical-surgical patient care. The head nurse of each unit provided the number of staff nurses as well as their characteristics including age, education, marital status, and years of nursing experience. Patient outcome variables included patient falls, pressure ulcers, respiratory tract infections, urinary tract infections, and patient/family complaints. Data on patient outcome occurrences were provided by the NQIC and the hospital infection control department. Patient acuity level was collected in the hospital information system on a daily basis and average daily acuity per month was reported to each nursing unit. The study was conducted and data were analyzed at the level of 21 medical-surgical nursing care units.

Nurse Staffing Variables

Daily average hours of care provided by RNs were calculated using only the hours of direct patient care from RNs divided by patient days. Direct patient care included general care needs: eating, toileting, cleansing, and activities, and therapy needs: vital signs, medication, respiratory care, special examination or treatments, on which RNs were assigned to provide care for a patient. The daily average hours of care provided by RNs of the 21 sample units ranged between 2.57 and 3.55, with a mean of 2.90 (SD = 0.29).

Ratio of RNs to average patient census was calculated as number of RNs in direct patient care divided by number of the average occupied inpatient census at the unit level. Mean of the ratio of RNs to average patient census was 0.44 (SD = 0.05), with a range of 0.34-0.55.

Workload index was drawn from the average utility index rate in terms of the amount of hours required for delivering nursing care. Utility index is a task oriented nursing workload measurement based on the recording and predicting of nursing interventions for individual patients. It was one of the items included in the hospital monthly statistical report of the patient classification system, and was calculated by dividing Patient Care Units (PCU) by Nursing Care Units (NCU) then multiplying by 100. PCU

was estimated as the total nursing hours needed by patients (including direct care, indirect care and teaching hours), whereas NCU was estimated as the actual nursing hours provided by nurses. Appropriate average utility index for a nursing unit is expected to range from 90 to 110%. It denotes overload if it is over 120%, and denotes underworkload if it is less than 80% (Anderson, 1997). The mean workload for the study was 134.29% (SD = 17.17) with a range of 108% to 179%.

Skill mix measured by the mix of three clinical ladders: N_1, N_2, and N_3 in each nursing care unit. Skill mix was then weighted by multiplying the number of nurses of each ladder in each unit into three different scores ($N_1 = 1$, $N_2 = 2$, $N_3 = 3$). The ladder of N_1, N_2, and N_3 was based on the requirements of the Nursing Clinical Ladder System (NCLS) provided by the Taiwan Nurses' Association. The weighted score of skill mix of the sample units ranged from 21 to 47, with a mean of 25.43 (SD = 5.66). The higher score the greater skills or experience of nurses in the unit.

Patient Outcome Variables

Patient falls were defined as suddenly and involuntarily leaving a position and coming to rest on the floor or some object (Reed, Blegen, & Goode, 1998). Data on patient falls were gathered from incident reports of the NQIC no matter whether injuries resulted or not. It was counted and standardized by calculating the number of patient falls on the unit each month per 1,000 patient days (falls/days).

Pressure ulcers were defined as new incidences of skin breakdown secondary to pressure or exposure to urine or feces (Reed, Blegen, & Goode, 1998). These data were collected through incident report documentation from the NQIC, and standardized by patient days.

Respiratory tract and urinary tract infections were the only two nosocomial infections included in this study since these are believed to be more sensitive to nursing care than other types of infection (Mark & Burleson, 1995). *Nosocomial infections* were defined as infections that express themselves in hospitalized patients in whom the infection was not present at the time of admission. Data on nosocomial infections was monitored and provided by the Department of Hospital Infection Control.

Patient/family complaints were defined as patient and family complaints about aspects of the patient's care such as nursing care, medical care, food, and housekeeping. Data were collected from a suggestion box located on each floor for patients and families to express their complaints freely in letters or notes and from the patient representative's office that received all complaints and compiled a monthly report for each unit. These letters, notes or reports were accumulated into a total number of complaints after excluding non-nursing related items, and then standardized as a rate per 1,000 patient days.

Patient Acuity Levels

Patient acuity reflects the severity of illness of a patient (Blegen & Vaughn, 1998). To control for patient severity, it is necessary to aggregate different types of patients with different levels of illness. Patient dependency levels were thus adjusted for patient acuity across units, which were readily available as monthly statistics in the patient classification system. This statistical report describes the application of a workforce planning tool, based upon GRASP (Grase-Reynolds Application and Study of PETO) systems workload methodology (Edwardson & Giovannetti, 1994), to identify staffing needs based on five patient dependency levels in nursing care units. The weighted mean of five patient acuity levels was 2.91 (SD = 0.23) with a range of 2.62 to 3.46, with 5 being totally dependent or requiring the most nursing care.

Procedures

After approval from the Hospital Review Board, data were obtained from the hospital computer system, the NQIC, managers of each unit, the department of hospital infection control, as well as the patient representative office. These data were then aggregated to an annual rate to minimize the effect of random fluctuations from month to month. Descriptive statistics such as mean, standard deviation, and range for each of the above variables and inferential statistics such as Pearson's correlation and linear regression analysis were applied to describe and examine the relationships between the variables, in which dummy variables were also created for the portion of the variable beyond the point where the regression line changed direction. Analyses of the data used two-tailed significance tests. Results meeting both alpha < .05 and alpha < .10 (.05 in each tail) are presented.

Results

The sample was composed of 347 FTE RNs distributed in 21 units with 793 beds ranging from 34 to 48 with a

mean of 37.76 beds, as well as 29,424 inpatients with a mean of 1406.8 per unit in FY 2000. A majority of the RNs were single (62%) in the age range from 21 to 35 years (N = 214, 61.67%) with education of senior nursing college (N = 223, 64%), and had at least five years' nursing experience (N = 168, 48.42%).

The daily average hours of care per patient were 2.9 ranging from 2.57 to 3.55, which reflects the range of patient acuity within these units. The ratio of RNs to average patient census was .44 (range from .34 to .55). The mean of the workload for the study units was 134.29% (1.3429 nursing hours), which represents overload or short staffing among nursing units. The skill mix of the RNs sampled was categorized as N_1 (N = 225, 64.84%), N_2 (N = 57, 16.43%) and N_3 (N = 65, 18.73%) based on the requirements for the Nursing Clinical Ladder System (NCLS) which were standardized by the Taiwan Nurses Association. Skill mix ranged from 21 to 47, with a mean of 25.43 (SD = 5.66) across all units. Rates of the five adverse patient outcome indices varied widely across the 21 units (Table 1).

The correlations among nursing staffing and patient outcome variables are presented in Table 2. There were significantly positive correlations between daily average hours of care and urinary tract infection ($r = .523$, $p < .05$) and patient falls ($r = .456$, $p < .05$). Ratio of RNs to patient census negatively correlated to patient falls ($r = -.483$, $p < .05$), urinary tract infection ($r = .397$, $p < .10$) and complaints ($r = -.440$, $p < .05$). There were positive and significant relationships between workload and respiratory tract infection ($r = .458$, $p < .05$), patients' complaints ($r = .20$, $p < .10$) and their acuity level ($r = .470$, $p < .05$). No significant relationships however, between skill mix and the five patient outcome indices were found in this study.

Inter-correlation among the five patient outcome indices was also examined by Pearson's correlation. Patient falls were positively correlated to pressure ulcers ($r = .479$, $p = .022$) and respiratory tract infections ($r = .475$, $p = .030$). Pressure ulcers were correlated to urinary tract infections ($r = .444$, $p = .044$). Inter-correlation among the four staffing variables was also examined and it was found that daily average hours of care were positively correlated to workload ($r = .520$, $p = .016$), and in turn, workload was positively correlated to acuity level. There was also a positive relationship between skill mix and the ratio of RNs to patient census ($r = .46$, $p = .036$).

Table 1.
Distribution of Nurse Staffing Variables and Patient Outcome Variables

Variables	M ± SD	Range (min - max)
Nurse Staffing Variables		
Daily average hours of care	2.90 ± 0.29	2.57 - 3.55
Ratio of RNs to patient census	.44 ± 0.05	.34 - .55
Workload index	134.29 ± 17.17	108 - 179
Skill Mix		
N1	10.71 ± 3.00	7 - 15
N2	2.71 ± 1.74	0 - 6
N3	3.10 ± 1.73	1 - 9
Weighted score	25.43 ± 5.66	21 - 47
Patient Outcome Variables		
Patients falls	4.52 ± 3.44	0 - 12
Pressure ulcers	9.24 ± 12.72	0 - 45
Respiratory tract infections	4.48 ± 4.37	0 - 14
Urinary tract infections	16.81 ± 9.63	0 - 40
Patient/family complaints	13.33 ± 18.53	0 - 81
Patient Acuity	2.91 ± 0.23	2.62 - 3.46

Note. All 21 medical-surgical units of the sample hospital were included.

Table 2.
Correlations for All Study Variables

	Falls		Pressure Ulcers		Respiratory Tract Infections		Urinary Tract Infections		Complaints		Acuity	
Variables	r	p	r	p	r	p	r	p	r	p	r	p
Average Hours of Care	.456	.038**	.332	.142	.311	.170	.523	.015**	-.209	.364	.748	.000***
Ratio of RNs to Patients	-.483	.027**	.224	.328	.226	.324	-.397	.075*	-.440	.046**	.121	.603
Workload Index	.133	.567	.349	.121	.458	.037**	.347	.123	.200	.093*	.470	.032**
Skill Mix	-.080	.730	-.137	.554	.351	.118	.153	.508	-.181	.433	.820	.724
Acuity	.352	.118	.290	.201	.418	.059*	.206	.370	.132	.567	-	

Note. Analyzed by Pearson's Correlation. * Two-tailed alpha < .10; **Two-tailed alpha < .05.

Patient acuity level can range from 1 through 5, with 5 being totally dependent or requiring the most nursing care. The average monthly patient acuity level was 2.91 (SD = .23) ranging from 2.62 to 3.46. The acuity measure and two staffing variables, daily average hours of care and workload, are significantly correlated (Table 2). This is undoubtedly owing to the use of the acuity measures to plan staffing. Although cost-containment efforts are put into decreasing lengths of hospital stay, the average nursing care needs of the patients in the hospital increase which is due to the higher acuity of patients. The units sampled by the current study are short of staff which resulted from further cost-containment efforts in an attempt to control the external economic environment. Furthermore, patient acuity was the only variable found to be significantly correlated with respiratory tract infection.

Two multivariate models were analyzed for each dependent variable. Acuity was included in model 2 and excluded in model 1. Multiple correlations and beta weights are shown in Table 3. The relative predictive value of acuity level is greater than that of the nurse staffing variables, but the hours of care and workload remain the best relative predictors. In addition, all nurse staffing variables from the regression analysis were significantly correlated with the five adverse outcomes, but in a different manner. The predicting power of each nurse staffing variable was strengthened while controlling for patient acuity levels. Predictors accounted for 50.5% of the variance of complaints whereas 37.9% when acuity level was excluded, and accounted for 85.7% of the variance of urinary tract infection whereas 79.9% when acuity level was excluded (Table 3).

Nurse staffing, the predictor variables explained 71.5% of the variance in patient falls; 44.9% in pressure ulcers; 63.6% in respiratory tract infections, 85.7% in urinary tract infections, and 50.5% of the variance in complaints (Table 3). It accounted for 53.3% of the variance in nosocomial infections (including urinary tract and respiratory tract infections), two of the criterion variables in the study (Equation 1). The relative predictive value of nurse staffing variables is greater with acuity included (Equation 2) than with it excluded (Equation 1).

Nosocomial Infections = -99.348 + .022 Hours of Care + .462 RN Ratio + .634 Workload - .233 Skill Mix (R^2 = .533, p < .05).....Equation 1

Nosocomial Infections = -85.489 + .195 Hours of Care + .400 RN Ratio + .634 Workload - .278 Skill Mix - .200 Acuity (R^2 = .548, p < .05).....Equation 2

Furthermore, size of the effects on the five adverse outcome variables was increased when acuity levels included. The multiple regression prediction equation 3 showed that the multiple R was .447 which accounted for 20% of the variance in the adverse outcome variables, and it increased to 30.4% with acuity included (Equation 4).

Adverse Outcomes = -72.413 + .870 Hours of Care + .135 RN Ratio + .397 Workload -.013 Skill Mix (R^2 = .200, p > .05).....Equation 3

Table 3.
Multiple Regression Models for Patient Outcome Variables

			Beta Weights for Predictors (Standardized Coefficients)					
Criterion Variable	Model	R^2	Daily average hours of care	Ratio of RNs/Pts.	Workload Index	Skill Mix	Patient Acuity	p Value
Patient Falls	1	.712	.110	-.117	-.086	-.059		.000*
	2	.715	.180	-.115	-.065	-.047	-.102*	.001*
Pressure Ulcers	1	.447	-.103	.169	.115	-.120		.065
	2	.449	-.037	.167	.135	-.109	-.096	.031*
Respiratory Tract Infection	1	.628	-.199	-.020	.201	-.096		.001*
	2	.636	-.089	-.022	.235	.115	-.161*	.004*
Urinary Tract Infection	1	.799	.064	-.033	.003	-.010		.000*
	2	.857	.359	-.026	.095	.041	-.431*	.000*
Patient/Family Complaints	1	.379	.128	-.181	.067	.044		.074
	2	.505	-.402	-.169	-.097	-.048	.773*	.013*

Note. *Two-tailed alpha < .05. Model 1 regression with Acuity excluded, Model 2 regression with Acuity included.

Adverse Outcomes = -145.205 + .370 Hours of Care + .299 RN Ratio + .397 Workload - .131 Skill Mix + .528 Acuity (R^2 = .304, p > .05).....Equation 4

In summary, the average hours of care, workload, and acuity level of patients were positively and strongly correlated with one another. Workload, acuity level, and respiratory tract infection were also strongly and positively correlated with one another. There were positive and significant relationships among patients' falls, pressure ulcers, and urinary tract infections; as well as between ratio of RNs and skill mix. Prediction that based upon each single predictor variable, the interpretation of R^2 as percent of criterion score variance accounted for by each predictor variable. The most powerful predictors of the five adverse patient occurrences thus were workload (R^2 = .167), hours of care (R^2 = .119), and skill mix (R^2 = .006), in that order. The best predictors of nosocomial infection were the average hours of care (R^2 = .279), workload (R^2 = .195), and ratio of RNs (R^2 = .158), in that order. Furthermore, the correlation coefficient in all five outcome indices became statistically significant when patient acuity was included. Therefore, acuity played a crucial role as a mediating variable between nurse staffing and patient outcomes.

Discussion

The current study used multiple adverse outcome indicators thought to be sensitive to nursing care. The study extended a growing body of research (ANA, 2000b; Blegen, Goode, & Reed, 1998; Blegen & Vaughn, 1998; Jackson, Chiarello, Gaynes, & Gerberding, 2002; Saver, 2001) about the relationship between nurse staffing and patient outcomes by using four different measures of nurse staffing: daily average hours of care, workload index, ratio of RNs to average patient census, and skill mix at the level of the nursing care unit. The study also used a wider range of outcome indicators by five adverse patient occurrences: patient falls, pressure ulcers, respiratory tract and urinary tract infections, and patients'/families' complaints at the nursing care unit level. It was hypothesized to be sensitive to nursing care and can reasonably be theorized to be preventable in some patients by the amount and skill mix of nursing care provided; also, the data are consistently available at the care unit level.

The relationships were present across adverse patient outcomes measured in different ways: nosocomial infections from the hospital infection control department, falls from the monthly report of the nursing quality improvement committee, pressure ulcers obtained from chart review, and complaints initiated by patients or their families. These outcome variables also illustrated the problem of causally linking nursing care processes to group-level outcomes. Measuring nursing-sensitive patient outcomes using existing available data provides exciting opportunities for the nursing profession to quantify the effects of different staffing on outcomes of patient care. The study tested the feasibility of measuring these five adverse patient occurrences in acute care settings and examined relationships between these outcomes and nurse staffing. The results indicated that information about all five indicators was collected and recorded consistently although only two nosocomial infections: respiratory tract and urinary tract infections were examined in this study.

The average hours of care delivered on a nursing unit by RNs was significantly correlated to the unit rates of two adverse patient occurrences: in this study urinary tract infection and falls. Urinary tract and respiratory tract infection rates were predicted by 53.3% of the variance in the nurse staffing variables (Equation 1). Relating urinary tract infection to the hours of care was contrary to Blegen, Goode and Reed's (1998) finding in which the data of infections obtained from chart review and deaths reported by the hospital morgue were very different from the data source of the current study. Data for the study were offered by the department of infection control which strictly controlled the quality of data collected. It however, is consistent with other research findings (Hunt & Hagen, 1998; Lichtig, Knauf, & Milholland, 1999). The higher average hours of care on a unit associated with the acuity of patients was also consistent with many research findings (Blegen, Goode, & Reed, 1998).

Ratio of RNs to patient census was inversely related to the unit rates of three adverse patient occurrences- patient falls, urinary tract infection and complaint- in this sample of 21 nursing care units. The proportion of RNs and the hours of care were associated with outcomes; which is consistent with many findings of outcome measures (Blegen, Goode, & Reed, 1998; Flood & Diers, 1988). In addition, given the high correlation between acuity and the average hours of care and workload of staff nurses, the interpretation of these coefficients has to be done with care.

Nurses' workload and its associated stressors are essential factors affecting nurses' health and in turn the

quality of care (Nuikka, Paunonen, Hanninen, & Lansinies, 2001). Results of the study showed that workload of nurses was significantly and positively correlated to respiratory tract infection, complaints and patient acuity; workload was also a powerful predictor of both nosocomial infection and the five adverse outcome indices. It can be suggested that nurse staffing and workload were related to the quality of nursing care provided.

Numerous factors in a hospital's environment are likely to have an impact on the incidence of the selected adverse outcomes. Nurse skill mix is one so basic to nurse staffing and patient outcomes that it was directly adjusted for in expressing the study's staffing and adverse outcome rate index variables. Lower adverse patient outcome occurrences were more consistently related to a higher proportion of N3 level of RNs. Patients can fare better when N3s play a significant role in the staffing mix.

Many researchers noted that medication errors are an appropriate outcome indicator for evaluating the effects of a restructured nursing care delivery model (Grillo-Peck & Risner, 1995; Mark & Burleson, 1995). Medication errors have been used as indicators of the quality of nursing care in several studies although not in relation to specific staffing levels. McCloskey (1998) also confirmed that units with patients who had higher acuity had lower rates of medication errors and falls and higher rates of other adverse outcomes. The current study, however, did not recruit "medication errors" as an outcome indicator due to the inconsistency and inaccuracy of the available data. Further research could examine the effect of staffing on medication errors by recruiting institutions having those data available, or by collecting such data for the purpose of research or quality management longitudinally.

It is also crucial to emphasize the difficulty of obtaining data measuring the amounts and types of nursing care being provided in acute care settings. Obtaining the data for this study required combining information from multiple hospital-wide data sources, a time-consuming process fraught with potential problems.

Nursing care affects the outcomes of hospitalized patients, but patient outcomes are also affected by other disciplines, the severity and complexity of the patient's condition, other characteristics of the patient, and the environment (Blegen, Goode, & Reed, 1998). Although this study controlled for patient acuity, Blegen, Goode, and Reed (1998) noted that "this indicator may not sensitive enough to control for the sharply higher acuity of patients on today's critical care and intermediate care units" (p. 49). The study recommends systematic research linking issues in regard to the relationship of environmental-related factors such as organizational structures and processes to patient outcomes.

Conclusion

The study yielded five major findings:

1. Acuity level played a crucial role as a mediating variable between nurse staffing and patient outcomes.
2. Lower adverse patient outcome occurrences were more consistently related to a higher proportion of N3 level RNs.
3. Workload, average hours of care, and skill mix are the best predictors on the five adverse patient occurrence indices.
4. Hours of care, workload, and ratio of RNs are the three most powerful predictors of nosocomial infections.
5. Nurse staffing and workload were related to the quality of nursing care provided.

The findings of this study show that problems with nurse staffing are associated with health care-associated infections and nursing-sensitive patient adverse events that affect patient outcomes. The study also provides an example of using publicly available data which is an exciting opportunity for the nursing profession to examine staffing-related nursing-sensitive patient outcomes. The author further suggests actions for nurse managers and researchers who have to address frequent queries as to the adequacy of nursing staffing.

Acknowledgments

This study was supported by a grant from the National Science Council, numbered NSC89-2314-B-075A-028. The author wishes to express thanks to the informants from Taichung Veterans General Hospital. Deep appreciation also goes to the research assistant, Chen-Kuan Huang and Yin-Yue Wong for their efforts on the data collection and analysis.

References

Aiken, L. H., Clarke, S. P., & Sloane, D. M. (2000). Hospital restructuring: Does it adversely affect care and outcomes? Journal of Nursing Administration, 30(10), 457-465.

American Nurses Association [ANA]. (2000a). Nurse staffing and patient outcomes in the inpatient hospital setting. Washington, DC: Author.

ANA. (2000b). Nursing-sensitive quality indicators for acute care settings and ANA's safety & quality initiative. Nursing facts: From the American Nurses Association. Available http://nursingworld.org/readroom/fssafe99.htm

Anderson, L. (1997). The role and resources required for the introduction of generic ward assistants using GRASP systems workload methodology: A quantitative study. Journal of Nursing Management, 5(1), 11-17.

Anderson, R. A., Su, H. F., Hsieh, P. C., Allred, C. A., Owensby, S., & Joiner-Rogers, G. (1999). Case mix adjustment in nursing systems research: The case of resident outcomes in nursing homes. Research in Nursing & Health, 22, 271-283.

Aydelott, M. K., & Tener, M. E. (1960). An investigation of the relation between nursing activity and patient welfare. Iowa City, IA: The University of Iowa.

Blegen, M. A., Goode, J. C., & Reed, L. (1998). Nurse staffing and patient outcomes. Nursing Research, 47(1), 43-50.

Blegen, M. A., & Vaughn, T. (1998). A multisite study of nurse staffing and patient occurrences. Nursing Economics, 16(4), 196-203.

Buerhaus, P. I., & Needleman, J. (2000). Policy implications of research on nurse staffing and quality of patient care. Policy Politics and Nursing Practice, 1(1), 5-15.

Edwardson, S. R., & Giovannetti, P. B. (1994). Nursing workload measurement systems. Annual Review of Nursing Research, 12, 95-123.

Flood, S. D., & Diers, D. (1988). Nurse staffing, patient outcome and cost. Nursing Management, 19(5), 34-43.

Grillo-Peck, A. M., & Risner, P. B. (1995). The effect of a partnership model on quality and length of stay. Nursing Economics, 13(6), 367-374.

Hodge, D. (2000). Nurses fight for patient safety. Tennessee Nurse, 63(2), 14-15.

Health Resources and Services Administration [HRSA]. (2001). HHS study links patient outcomes and nurse staffing. News: ANA News. Available http://www.bhpr.hrsa.gov/dn/staffstudy.htm

Hunt, J., & Hagen, S. (1998). Nurse to patient ratios and patient outcomes. Nursing Times, 94(45), 63-66.

Iezzoni, L. I. (1997). Risk adjustment for measuring health care outcomes. Ann Arbor, MI: Health Administration Press.

Jackson, M., Chiarello, L. A., Gaynes, R. P., & Gerberding, J. L. (2002). Nurse staffing and health care-associated infections: Proceedings from a working group meeting. AJIC: American Journal of Infection Control, 30(4), 199-206.

Jones, K. R. (1993). Outcomes analysis: Methods and issues. Nursing Economics, 11(3), 145-152.

Kovner, C., & Gergen, P. J. (1998). Nurse staffing levels and adverse events following surgery in U.S. hospitals. Image: Journal of Nursing Scholarship, 30, 315-321.

Lichtig, L. K., Knauf, R. A., & Milholland, D. K. (1999). Some impacts of nursing on acute care hospital outcomes. Journal of Nursing Administration, 29(2), 25-33.

Mark, B. A., & Burleson, D. L. (1995). Measurement of patient outcomes: Data availability and consistency across hospitals. Journal of Nursing Administration, 25(4), 52-59.

McCloskey, J. M. (1998). Nurse staffing and patient outcomes. Nursing Outlook, 46(5), 199-200.

Minnick, A., & Pabst, M. K. (1998). Improving the ability to detect the impact of labor on patient outcomes. Journal of Nursing Administration, 28(12), 17-21.

Murphy, E. C. (1993). Cost-driven downsizing in hospitals: Implications for mortality. Amherst, NY: The Quality Lender Press.

Nuikka, M. L., Paunonen, M., Hanninen, O., & Lansinies, E. (2001). The nurses' workload in care situations: Experience before and through the nursing career. Journal of Advanced Nursing 33(3), 406-415.

Porell, F., Caro, F. G., Silva, A., & Monan, M. (1998). A longitudinal analysis of nursing home outcomes. Health Services Research, 33(4 Pt1), 835-865.

Reed, L., Blegen, M. A., & Goode, C. (1998). Adverse patient occurrences as a measure of nursing care quality. Journal of Nursing Administration, 28(5), 62-69.

Safford, B. J., & Schlotfeldt, R. M. (1960). Nursing service staffing and quality of nursing care. Nursing Research, 9(3), 149-154.

Saver, C. (2001). New study finds strong link between patient outcomes and nurse staffing. Nursing Spectrum, 5(10), 17.

Shortell, S. M., Zimmerman, J. E., Rousseau, D. M., Gillies, R. R., Wagner, D. P., Draper, E. A., Knaus, W. A., & Duffy, J. (1994). The performance of intensive care units: Does good management make a difference? Medical Care, 3(5), 508-525.

Smith, A. P. (2002). Evidence of our instincts: An interview with Linda H. Aiken. Nursing Economics, 20(2), 58-61.

Yang, K. P. (1997). Evaluation of the quality of nursing process in a medical center in Taiwan. VGH Nursing, 14(1), 62-73.

Yang, K. P. (1998). Reconsideration of nursing diagnosis: Nursing-sensitive patient outcomes classification. The Journal of Nursing, 45(2), 40-46.

Yang, K. P., Simms, L. M., & Yin, J. C. (1999, August 3). Factors influencing nursing-sensitive outcomes in Taiwanese nursing homes. Online Journal of Issues in Nursing. Available http://www.nursingworld.org/ojin/tpc7_5.htm

Yin, J. C., & Yang, K. P. (2002). Nursing turnover in Taiwan: A meta-analysis of related factors. International Journal of Nursing Studies, 39, 537-581.

護理人力配置與病患結果之相關性

楊克平

摘　要： 許多研究曾顯示護理實務或作業上的改變會影響護理人員與組織結果，然對其顧客，病患結果的影響卻鮮少探究，致未能充份瞭解其間之關係或影響力。本研究之目的在檢視護理人力配置之相關變項，如各護理單位之平均護理時數、護理師與平均病患數之比、工作量與各級護理師之組合比等對病患結果之影響。而病患結果則以跌倒、壓瘡、呼吸道感染、泌尿道感染及病患或家屬之抱怨率等五種負向結果為評量指標。本研究以回溯性 (retrospective) 方式，針對台灣地區某 1394 床之醫學中心的 21 個內外科住院病患 2000 年之護理品質監測記錄、病患記錄、病患分類系統資料及護理人員配置等資料分析。護理人力配置變項與結果變項間之相關性在控制病患嚴重度(patient acuity)後，以多變項分析(multivariate analysis)處理資料。病患嚴重度與護理時數則以病患分類系統電腦資料庫中擷取。研究結果顯示護理人員的工作量是院內感染的最佳預測指標；而平均護理時數則是五項病患負向結果的最好預測因子。此外，N3 佔各級護理師比率較多的單位，其病患之負向結果發生率亦較低。N3 或以上層級之護理師人力組合比 (staffing mix) 在維護病患的利益上佔了舉足輕重的角色。本研究結果提供了病患結果 (outcome) 與組織結構 (structure) 有關的實證資料，更突顯了護理人力配置在護理實務品質上的重要性。

關鍵詞： 護理人力配置、病患結果、病患之負向結果發生率。

私立耕莘護理專科學校校長
受文日期：92 年 2 月 11 日　修改日期：92 年 5 月 26 日　接受刊載：92 年 6 月 16 日
通訊作者地址：楊克平　231 台北縣新店市中正路 364 號