

Is More Better?

The Relationship Between Nurse Staffing and the Quality of Nursing Care in Hospitals

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Objective: The objective of this study was to examine the effects of nurse staffing and process of nursing care indicators on assessments of the quality of nursing care.

Research Design: This study examined the variation in inpatient hospital staff nurses' assessments of the quality of nursing care and the effects of nurse staffing (patient workload), patient safety problems (medication errors and patient falls with injuries), and unfinished care (number of nursing tasks left undone) on the variation in those assessments. Secondary analysis of a survey of nurses using multivariate regression models was undertaken.

Subjects: Data were derived from a 1999 statewide survey of 8670 inpatient staff nurses working in acute care hospitals in Pennsylvania.

Results: Quality of nursing care ratings were significantly associated with the number of patients who nurses care for, rates of unfinished care for those patients, and the frequency of patient safety problems. The effect of patient workload on quality ratings was attenuated substantially by the effects of unfinished care and patient safety problems. Unfinished care had the strongest relationship of all, with over 40% of the variation in quality ratings associated with the number of tasks left undone.

Conclusions: Assessments of the quality of nursing are associated with both structural (workload) and process of care indicators (unfinished clinical care and patient safety problems), with the relationship strongest between process of care and quality. Exploring the interrelationship between structure and process of care is key to understanding the influence of both on quality. Studies that

assess the causal influence of these features on quality of care and patient outcomes are warranted.

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Studies noting variation in hospital patient outcomes, now nearly 3 decades in the making, have fueled the search for the etiology of these differences, and the role of quality of care in producing the differences that have been found in outcomes.¹ The focus on quality has been heightened by 2 landmark reports issued recently from the Institute of Medicine: *To Err is Human*² and *Crossing the Quality Chasm*.³ Each report exposed serious gaps in the U.S. healthcare system's efforts to deliver safe, efficient, and high-quality patient care, and sounded the call for systemic initiatives to bridge those gaps. These initiatives include changes in both the structure and the processes of care such as the recommendations from the Leapfrog Group for the use of physician "intensivists" in intensive-care units and computer physician order entry systems for drug dispensing.

Initiatives directed toward nursing have largely focused on assuring adequate staffing levels as the vehicle through which outcomes and quality are improved. Studies attesting to the impact of nurse staffing on patient outcomes date back several decades, and have culminated in the last 5 years in an array of studies affirming that effect.^{4–12} These recent studies responded to the Institute of Medicine's call to develop a more rigorous empiric base on the impact of nurse staffing and the work environment on patient outcomes and quality of care, and in particular the mechanisms by which nursing influenced those outcomes.¹³ Although the evidence of the staffing effect on outcomes is clear, the mechanism by which its effect is rendered is much less so. Nonetheless, these studies have motivated nearly half of the states in the United States to explore the adoption of minimum nurse staffing ratios in hospitals. Yet, attempting that in the absence of a clear understanding of how and why different staffing levels affect outcomes could result in ratios that overestimate or underestimate what is really needed to improve patient care.

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This study endeavors to take a first step in addressing that question by assessing whether nursing workload is associated with nurses' reports on the quality of nursing care in hospitals, and whether workload is related to indicators of the process of nursing care that also are associated with quality care. The conceptual framework for this study derives from Donabedian's structure-process-outcomes model of quality,¹⁴ and posits that effect of nurse staffing, a structural element, on the quality of nursing care is expressed in part through its effect on the process of care. To that end, this study tests the combined effects of structure and process on ratings of the quality of nursing care. This study is a secondary analysis of data from a 1999 statewide survey of hospital staff nurses in Pennsylvania that was part of a 5-country cross-sectional study designed to explicate the relationship among nurse staffing, work environment, and patient outcomes.¹⁵ Over 43,000 nurses who worked in nearly 700 hospitals in these countries were surveyed. This study reports on the data from nurses working in acute care hospitals in Pennsylvania, the U.S. component of the 5-country study.

MATERIALS AND METHODS

Study Sample

A 9-page survey designed to collect information on patient workload, quality of care, work environment, and other nursing care features in acute care general hospitals^{15,16} was sent to a 50% random sample of licensed RNs in Pennsylvania ($n = 80,500$) in February 1999. The survey mailing was conducted using a modified version of Dillman's¹⁷ guide to mail and telephone surveys. All nurses in the sample were sent a survey with an accompanying cover letter explaining the purpose of the survey, its voluntary nature, and the strict protection of anonymity. A postcard reminder was sent out 2 weeks later to the entire sample to both thank respondents and to encourage nonrespondents to participate. A follow-up survey was sent 2 weeks later to all remaining nonrespondents.

A list of all hospitals in the state was included in the survey, and respondents were asked to indicate the hospital where they worked. This information was used to identify nurses who worked in adult acute care general hospitals in the state; less than 1% of respondents could not be linked to a facility and consequently were excluded from the sample. A total of 42,219 surveys were returned for a 52% overall response rate. Forty-one percent of all respondents ($n = 17,229$) reported working in a hospital. This group included 13,190 nurses who worked in adult acute care general hospitals, 11,628 of whom were staff nurses caring for patients. All respondents were assigned to 1 of 15 unit types or categories based on information provided in the survey: 9 categories for inpatient care units (medical-surgical, intensive care, pediatrics, neonatal intensive care, rehabilitation,

psychiatry, labor and delivery, operating room, and subacute care), 3 categories for outpatient and ambulatory clinics and specialty units such as cardiac catheterization laboratory, and 3 categories for other inpatient nurses who are not assigned regularly to specific patient care unit such as case management nurses. Only 81 nurses (0.7%) did not indicate their unit assignment, leaving 11,547 nurses. Among them, 9743 worked on 1 of the 9 inpatient care units and were the target of this study; three fourths of these nurses worked on 1 of 7 general inpatient units and the remainder worked on the 2 intensive-care units.

Formal tests of nonresponse bias were not possible; instead, comparative analyses were undertaken between the study sample and the sample of RNs who reported working in hospitals in Pennsylvania from the 2000 National Sample Survey of Registered Nurses (NSSRN). At 41%, the proportion of respondent working in hospitals in the study sample was comparable to the 42% of all licensed RNs in Pennsylvania from the NSSRN who likewise worked in hospitals. The mean age for the target sample, the 9743 inpatient staff nurses, was 39.1 years, 37.9% had at least a baccalaureate degree in nursing, 62.5% worked full-time, and 5.7% were male. In comparison, among inpatient staff nurses working in hospitals in Pennsylvania from the NSSRN, the average age was 39.7 years, 35.3% had a baccalaureate degree or higher, 67.1% worked full-time, and 7.8% were male. Chi-square and means tests between these 2 samples on each feature found no statistically significant differences on any. Furthermore, there was no difference found in reported mean level of job satisfaction between nurses in both samples. The comparability of the study sample to that from a national survey that sampled nurses throughout the state and that had a response rate of 76% provides evidence that the study sample is representative of hospital nurses in Pennsylvania.⁴ Finally, there was a strong linear association ($r = .93$) between the number of survey respondents from each hospital and the total number of nurses working at each hospital obtained from hospital facility data files, offering evidence of similar response rates across hospitals.

Study Measures

The 9-page survey mailed to all RNs comprised validated instruments, scales, and items capturing features of the work environment and the nurses' personal characteristics, which is described in detail elsewhere.^{4,15,16} The following measures were derived from the survey items.

Quality of Nursing Care

The quality of nursing care was assessed by an item in the survey that asked "In general, how would you describe the quality of nursing care delivered to patients on your unit on your last shift?," and for which a 4-category response was available (poor, fair, good, excellent). Single items for overall

assessment of quality have been used in a number of studies assessing the quality of medical and nursing care and have been found to be strongly associated with process of care criteria as well as patient outcomes.^{18–20} Reporting on a single shift rather than some general time period is less burdensome, and the average across all nurses offers a reasonable appraisal of overall quality of care.

Patient Workload

Each nurse was asked to report the number of patients for whom they provided direct patient care on their last shift. A patient workload between 1 and 20 patients for nurses on any of the 7 general inpatient units and between 1 and 6 patients for nurses on either of the 2 intensive-care units was deemed to be within reasonable bounds, and these thresholds were used to define the workload measure.

Tasks Undone

Nurses were asked to indicate which nursing tasks, among a list of 7 provided in the survey, went undone during their last shift because they lacked the time to undertake them. These tasks included such things as patient teaching and counseling, skin and oral care, documenting patient problems and interventions, and discharge planning. These items overlap with those included in other tested instruments assessing provider perceptions of quality of care.^{21,22} This measure was a sum of all uncompleted tasks checked off, ranging from 0 to 7 tasks.

Patient Safety Problems

The survey included 2 questions that asked nurses to rate, each on a 4-point scale from never to frequently, as to how frequently the following patient safety problems occurred among patients under their care over the past year: medication errors (wrong medication or dose administered) and patient falls with injuries. Both medication errors and patient falls have been used in a number of studies as indicators of the quality of nursing care. Responses to these 2 items in the survey were moderately correlated ($r = .44$, $P < 0.001$). Guttman scaling techniques were used to create a single 10-category scale from these 2 items that measured increasing degrees of frequency among these 2 patient safety problems, ranging from neither occurring ever in the past year (score = 1) to both occurring frequently (score = 10).

Data Analysis

The primary analyses involved examining the variation in quality of nursing care assessments among nurses, the relationship between these assessments and patient workload, and the combined effects of workload and 2 process of care indicators, patient safety problems and unfinished nursing care, on these quality assessments. Descriptive statistics were used to examine the distribution and characteristics of all key

study variables. Bivariate correlation testing among all study variables was used to assess the presence and strength of their relationships. Multivariate regression models were used to assess the combined effects of all study measures on quality of care. A series of models were undertaken in which quality of nursing care was regressed sequentially on patient workload, patient safety problems, and tasks undone. Robust regression procedures were used to account for the effects of having nurses clustered within hospitals. In each model, standard errors were estimated using the Huber and White estimator of variance to adjust for the clustering of nurses within hospitals.²³ The residuals obtained from the regression model were normally distributed, substantiating the use of linear regression models in these analyses; the Jacque-Bera test result ($\chi^2 = 52.21$, $P < 0.001$) confirmed this finding. Ordered logit models were also run (not shown) and confirmed the results from the linear models. All analyses were conducted using casewise and listwise case deletion procedures, and no differences were noted in the results under either method. All analyses reported here employed listwise case deletions, with a resulting sample of 8670 nurses. This analysis sample did not differ from the target sample ($n = 9743$) on any of the key study variables or on demographic characteristics (ie, age, education, full-time status, or gender).

RESULTS

Among the 8670 nurses in the sample, 6329 (73%) worked in 1 of the 7 categories of general inpatient units, over half of whom worked on medical–surgical units and 2341 (27%) worked in 1 of the 2 intensive-care unit categories (Table 1). Nurses reported caring for 5.3 patients (standard deviation [SD] ± 3.4) on average across all respondents. That figure derives from an average of 6.3 patients (SD ± 3.4) among nurses on general inpatient units and 2.4 patients (SD ± 0.9) among intensive-care unit nurses, comparable to workload averages reported elsewhere.²⁴ On average, nurses left 2.1 tasks undone at the end of their last shift, with 40% reporting 3 or more unfinished tasks. Sixteen percent reported that medication errors occurred more than rarely among their patients over the past year, and more than 1 of every 5 nurses reported patient falls with injuries occurred occasionally or frequently. The mean patient safety problems score, providing an aggregate look at these 2 events, was 3.1 (range, 1–10). Twenty-three percent of respondents had a score of 1, indicating that neither event occurred among their patients in the last year, whereas roughly the same percentage (26%) reported a score of 5 or higher, indicating that at least 1 of the 2 events occurred occasionally or more often among their patients. One fourth of all respondents reported the quality of nursing care was excellent on their unit, balanced by just over 20% reporting it to be fair or poor.

Each of the study variables had a linear relationship with quality of care (Table 2). The mean number of patients

TABLE 1. Distribution of Nurse Sample Across Selected Structure, Process of Care, and Quality Indicators (n = 8670)

Study features	
General care units (n = 6329)	
Medical–surgical	3465
Labor/delivery	1026
Operating room	743
Pediatrics	327
Psychiatric	393
Rehabilitation	221
Geriatric	154
Intensive-care units (ICU) (n = 2341)	
Intensive care	2143
Neonatal ICU	198
Patient workload (no. of patients) (mean, S.D.)	
Overall	5.3 (3.4)
General care	6.3 (3.4)
Intensive care	2.4 (0.9)
Tasks left undone (mean, S.D.; range 0–7)	
	2.1 (1.9)
Occurrence of medication errors (%)	
Never	35.1
Rarely	48.5
Occasionally	15.4
Frequently	1.0
Occurrence of falls with injury (%)	
Never	42.2
Rarely	35.6
Occasionally	19.2
Frequently	3.0
Patient safety score (mean, S.D., range 1–10)	
	3.1 (2.0)
Quality or care assessments (%)	
Poor	1.5
Fair	18.8
Good	53.4
Excellent	26.3

SD = standard deviation.

assigned to nurses declined across the range of quality scores, falling by half as quality ratings rose from poor to excellent. Similarly, the number of unfinished tasks fell from more than 5 to less than 1 as quality of nursing care assessments increased. Patient safety problems ratings likewise declined by half as quality assessments improved.

Bivariate correlation coefficients provided evidence of the presence and strength of the interrelationship among the study variables (Table 3). Assessments of the quality of nursing care exhibited a strong relationship with the number

of tasks left undone ($r = .634, P < 0.001$). Although more modest in size, these quality assessments also had significant relationships with patient safety problems as well as with patient workload. Workload, a structural feature, was also moderately, although significantly, associated with the 2 process of care indicators, patient safety problems and unfinished care.

Multivariate linear regression models were used to examine the contributions of workload, tasks left undone, and patient safety problems to the quality of nursing care (see Table 4). In model 1, the addition of each patient to the nurse's workload is associated with a .07 point decline in quality scores, and this effect was statistically significant. Mean quality scores declined from 3.6 (excellent/good) to 2.7 (good/fair) as the number of patients cared for rose from 1 to 10 and plateaued after that point. Patient safety problems also contributed to quality scores (model 2), with mean quality assessments declining 0.12 points for each point increase in the patient safety problems score. Compared with workload, quality assessments dropped more precipitously as patient safety problems score rose, from 3.3 (excellent/good) to 1.9 (fair/poor) along its 10-point scale. Unfinished care had a pronounced effect on quality of care ratings, which declined 0.24 points with each additional task left undone (model 3). Quality scores fell in a similar manner to patient safety problems, from 3.6 (excellent/good) to 2.1 (fair) as the amount of unfinished care grew.

Part of the effect of workload on quality ratings is mediated by patient safety ratings, with the coefficient for workload in model 4 being 30% lower than that found in model 1 after taking into account the effect of patient safety problems on quality, although it remained statistically significant. In more striking fashion, the coefficient for patient workload declined by over 50% between models 1 and 5, the result of including unfinished care in a model with patient workload. In model 6, in which all 3 variables are included, each continues to contribute significantly to the variation on nursing quality assessments, although the coefficient for patient workload is reduced to two thirds of its size from model 1 in which it was the sole covariate. Between models 1 and 6, there was a 4-fold increase in the proportion of the variance explained in the ratings on the quality of nursing care, from 10% to 43%. The association between unfinished care and quality produced the largest share of the explained variance.

DISCUSSION

This study sought to deconstruct nurses' reports of the quality of nursing care, and to determine the degree to which workload and process of nursing care indicators were associated with these assessments. These analyses show that workload has a significant effect on quality of

TABLE 2. Mean (S.D.) Scores for Patient Workload and Process of Care Indicators by Ratings of the Quality of Nursing Care (n = 8670)

Quality Rating	Structure and Process of Care Indicators		
	Patient Workload*	Patient Safety Problems score [†]	Tasks Undone [‡]
Poor (n = 127)	8.04 (4.17)	5.47 (2.75)	5.28 (1.37)
Fair (n = 1633)	6.85 (3.53)	4.18 (2.33)	4.02 (1.54)
Good (n = 4627)	5.37 (3.28)	3.06 (1.87)	2.13 (1.64)
Excellent (n = 2283)	3.80 (2.75)	2.25 (1.43)	0.54 (1.04)
F test	322.77 (3,8666)*	404.79 (3,8666) [§]	1955.56 (3,8666) [§]

*The number of patients ranges from 1–20 for general care units and 1–6 for intensive-care units.
[†]Scores range from 1–10 with higher scores indicating greater frequency of patient safety problems.
[‡]The number of unfinished tasks ranges from 0–7.
[§]P < 0.001.
 SD = standard deviation.

TABLE 3. Pearson Correlation Coefficients Between Quality of Nursing Care, Patient Workload, and Process of Care Indicators (n = 8670)

	Quality of Care	Patient Workload	Patient Safety Problems
Patient workload	.317*		
Patient safety problems	.348*	.337*	
Tasks undone	.634*	.284*	.336*

*P < 0.001.

nursing care ratings. Although its effect is attenuated by both patient safety scores and tasks left undone, it continues to have an independent and significant effect on quality of care. Furthermore, the attenuation of its effect suggests that workload affects quality of care both directly as well as through its effects on patient safety and unfinished work, the ratings for which are significantly related to workload.

Process of care indicators, however, had even more pronounced effects on quality ratings. Patient safety scores were significantly associated with quality ratings, and their inclusion improved the variance in quality ratings explained by 65% over a model that solely examined the effect of workload. The significant association between quality assessments and patient safety problems suggests that nurses' appraisals of the quality of their care are congruent with the ratings on an important indicator of the product of that care. Moreover, the analyses suggest that although workload could be one factor associated with greater frequency of patient safety problems, other features in the work environment are also playing important roles and could be interfering with nurses' efforts to reduce their

occurrence, leading to lower assessments of the quality of care. The strong association between tasks undone and quality of care further suggests that nurses' assessments of quality could provide a critical overview of the process of care: the clinical interventions that comprise the nursing care that patients receive. Although enumerating unfinished care does not fully capture the entire process of nursing care, it could serve as a reasonable indicator of the quality of the process of that care.

As mentioned previously, single overall assessments of the quality of care have corresponded to assessments of the process of care derived from an inventory of care activities associated with quality care.^{18–20} A single global item could capture not only a broad set of attributes, but also the more intangible aspects of care that might not lend well to measurement no matter how lengthy the scale. The shared effects between workload and tasks undone on quality ratings suggests that higher workload could be influencing quality of care through its effects on the nurse's capacity to deliver needed care. Furthermore, there is considerable residual in both quality ratings and tasks undone that are not explained by workload, suggesting that other forces in the work environment are exercising their influence on both. The strength of the association between tasks undone and quality ratings could be influenced by the structure of the survey items, ie, the time period of both the quality rating and the accounting of unfinished care (last shift) that have inflated its role in quality ratings relative to patient safety reports, which reflect the occurrence of patient safety problems over the past year. However, the workload item was also a contemporaneous measure and its association, although significant, was less than that of both patient safety and unfinished care.

There are several limitations to this study. The data are all cross-sectional, which does not permit inference of

TABLE 4. Regression Coefficients and Robust Standard Errors From Linear Models Regressing Quality of Nursing Care Assessments on Patient Workload, Patient Safety Problems, and Tasks Undone (n = 8670)

	Patient Workload	Patient Safety Problems	Tasks Undone	R ²
Model 1	-0.067 (0.003)*			.1003
Model 2		-0.124 (0.004)*		.1208
Model 3			-0.235 (0.004)*	.4018
Model 4	-0.047 (0.003)*	-0.097 (0.004)*		.1657
Model 5	-0.031 (0.002)*		-0.220 (0.004)*	.4222
Model 6	-0.025 (0.002)*	-0.043 (0.003)*	-0.208 (0.004)*	.4340

Dependent variable: quality of nursing care assessment (4 category variable, in which 1 = poor, 2 = fair, 3 = good, 4 = excellent).

**P* < 0.001.

causality. The associations denoted in these analyses suggest that a longitudinal study of the impact of changes in workload on quality and patient outcomes is in order, but this study is not positioned to answer those questions. The different time periods over which the key study variables were assessed (over the past year for patient safety, and last shift for all other variables) could have influenced the strength of the associations found in both the bivariate and multivariate analyses. Although the relative associations might look different in models in which the measures all reflect the same period, 2 of the 3 measures are contemporaneous, and conclusions about the importance of both the structure and process in quality assessments can still be drawn from these analyses. In addition, the relatively less-pronounced association between patient safety and quality ratings could indicate that the occurrence of these events, in the estimation of the nurse respondents, is a function not only of nursing care, but also a host of factors beyond nursing and over which nursing has little if any control. Finally, these data are all based on self-report and could be subject to respondent bias associated with self-report. They also rely of subjective judgments of several key study variables. The standard of "excellent" quality of nursing care could vary across respondents, for example. Although these types of response categories are commonly used in a wide variety of measures included in survey research and found to be reliable and valid indicators, there could nonetheless be some unmeasured bias in these responses.

CONCLUSIONS

Nursing workload, shown to be an important contributor to the outcomes of hospital patients in studies over the past several decades, is shown here to be associated with assessments of the quality of nursing care as well as with indicators of the process of care. These process of care indicators are likewise related to quality assessments with

effects that are even more pronounced than that of workload. Examining the effects of both workload and quality of care indicators in models assessing the impact of nursing on patient outcomes, particularly using longitudinal data, would allow us to explicate the mechanisms through which both affect patient outcomes, and thus inform hospital administrators and policymakers on the strategies that should be sought to improve the quality of patient care.

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