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## Nursing care quality and adverse events in US hospitals

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### Abstract

**Aim**—To examine the association between nurses' reports of unmet nursing care needs and their reports of patients' receipt of the wrong medication or dose, nosocomial infections and patient falls with injury in hospitals.

**Background**—Because nursing activities are often difficult to measure, and data are typically not collected by health care organisations, there are few studies that have addressed the association between nursing activities and patient outcomes.

**Design**—Secondary analysis of cross-sectional data collected in 1999 from 10,184 staff nurses and 168 acute care hospitals in the US.

**Methods**—Multivariate linear regression models estimated the effect of unmet nursing care needs on adverse events given the influence of patient factors and the care environment.

**Results**—The proportion of necessary nursing care left undone ranged from 26% for preparing patients and families for discharge to as high as 74% for developing or updating nursing care plans. A majority of nurses reported that patients received the wrong medication or dose, acquired nosocomial infections, or had a fall with injury infrequently. However, nurses who reported that these adverse events occurred frequently varied considerably [i.e. medication errors (15%), patient falls with injury (20%), nosocomial infection (31%)]. After adjusting for patient factors and the care environment, there remained a significant association between unmet nursing care needs and each adverse event.

**Conclusion**—The findings suggest that attention to optimising patient care delivery could result in a reduction in the occurrence of adverse events in hospitals.

**Relevance to clinical practice**—The occurrence of adverse events may be mitigated when nurses complete care activities that require them to spend time with their patients. Hospitals should engage staff nurses in the creation of policies that influence human resources management to enhance their awareness of the care environment and patient care delivery.

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## Keywords

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## Introduction

Nursing organisations have made efforts to improve staffing levels as a system-level intervention aimed at improving quality and outcomes without fully understanding the mechanism by which different nurse staffing levels affect outcomes. Inadequate nurse staffing has been associated with medication errors (Blegen & Vaughn 1998), patient falls (Blegen & Vaughn 1998, Unruh 2003, Krauss *et al.* 2005), the spread of infection (Fridkin *et al.* 1996, Kovner *et al.* 2002, Stone *et al.* 2007), increased mortality (Aiken *et al.* 2002, Estabrooks *et al.* 2005) and failure-to-rescue (Aiken *et al.* 2002, Needleman *et al.* 2002). Nursing care activities are often difficult to measure, and data are typically not collected by health care organisations; therefore, there are few studies that have addressed the association between the actual activities of nursing care and patient outcomes. A consequence is that the assessment of nursing care is emphasised rarely in efforts to improve health care (Maas & Head 1998). It is therefore imperative to examine the relationship between nursing care and patient outcomes.

The purpose of this article is to examine empirically the association between registered nurses' (nurses) reports of unmet nursing care needs and their reports of patients receiving the wrong medication or dose, nosocomial infections and patient falls with injury (i.e. adverse events). The study is designed to also take into account patient and care environment variables. We developed a survey-based nursing care quality indicator (i.e. unmet nursing care needs) by asking hospital bedside nurses to report necessary nursing care left undone.

## Background and significance

The conceptual framework, the Process of Care and Outcomes Model (PCOM) (Lucero *et al.* 2009) that guided this study has origins in Donabedian's (1988) quality paradigm and the Quality Health Outcomes Model (Mitchell *et al.* 1998). The PCOM posits a temporal relationship among the care environment, patient factors, the process of care and outcomes. The traditional structural characteristics of the nursing and hospital organisation are built-in the care environment. The care environment and patient factors have a direct relationship on outcomes. In contrast to Donabedian's view that interventions directly produce expected outcomes, the PCOM suggests that the effect of an intervention is mediated by system and client characteristics, but is thought to have no independent direct effect.

While the quality paradigm emphasises doing things right, this study explored the quality of care by examining necessary 'things' left undone by nurses. As nurses are continually adapting to changes in the care environment and patients' health status, the association between the quality of nursing care and outcomes may be influenced by both patient factors and the care environment. Nursing care can be thought of as a health care organisation's surveillance function for the early detection of deterioration in patients' health status. In this study, registered nurses' reports of 'unmet nursing care needs' provide a measure of what nurses were not able to do for patients and serves as a hospital-level nursing care quality indicator.

One of the earliest large-scale studies (Lindeman *et al.* 1978) that examined the relationship between nursing care and outcomes described selected nursing care activities and patient's

health status during preoperative, intraoperative and postoperative periods of care. The performance of 'significant nursing activities' ranged from 63% for the use of 'special devices' to 86% for recording 'relevant information.' An initial list of 151 nursing activities was reduced to 10 by systematically observing nurses at work, a review of the literature, peer review and data collection on significant nursing activities. In the final analysis, the data did not reveal any significant relationships between nursing activities and health status across the three surgical periods.

Explicit structured review of quality has been used to measure and examine the nursing care–outcome link. Before and after the implementation of the prospective payment system (PPS), researchers found significant differences in the effects of nursing care on severity-adjusted 30- and 180-day mortality (Kahn *et al.* 1990). The implementation of the PPS was not associated with worsening care, even in areas that were affected by financial incentives to decrease services, such as nurse staffing. Additionally, the 24% decrease in length of stay after the introduction of the PPS was not associated with deterioration in nursing care.

Based on predictions of the Nursing Role Effectiveness Model (Irvine *et al.* 1998), research has documented the influence of nursing care on outcomes (Doran *et al.* 2002, Doran *et al.* 2006). In this model, nursing care is classified according to nursing role performance. The independent nursing role focuses on the functions and responsibilities that nurses are held accountable for in the care environment. The interdependent nursing role is concerned with the functions that are partially or totally dependent on other health care providers and vice versa. The dependent nursing role is concerned with the functions and responsibilities associated with implementing medical orders and treatments.

Doran *et al.* (2006) found independent nursing care such as patient positioning, self-care assistance (e.g. oral hygiene) and exercise promotion was significantly associated with patient's functional status at discharge. In another study (Doran *et al.* 2002), patients' perceptions of the quality of nursing care was associated with their functional status, therapeutic self-care and mood disturbance. Nurses' perception of the effectiveness of coordination within and between units and communication between nurses and between nurses and physicians (i.e. interdependent role) were associated with patients' functional status and mood disturbance. The effect of nursing's dependent role was not tested in these studies (Doran *et al.* 2002, Doran *et al.* 2006).

A review (Bolton *et al.* 2007) of systematic/integrative reviews and meta-analyses published between 1999–2005 described the empirical findings of the relationship between nursing interventions/processes and patient outcomes in acute care settings. The clinical topics selected 'represented areas of patient care intervention research that were viewed as highly sensitive to nurse actions... in acute direct patient care roles' (Bolton *et al.* 2007, p. 126S). The studies analysed focused primarily on nursing structural and process variables. The principal finding from this investigation was the dearth of data directly linking nursing care to patient outcomes. There were some exceptions where intervention studies documented a link between provision of patient education and self-care practices; support for the management of anxiety, depression, asthma and symptom management; and the promotion of health and disease prevention.

Little is known about the effects of nursing care on hospitalised patients. This study explores the association of unmet nursing care needs, an indicator of the quality of nursing care and outcomes using multiple large data sets. Establishing an empirical link between unmet nursing care needs and outcomes will support a theoretical link between nursing care and quality of care.

## Methods

This study is a secondary analysis of cross-sectional data collected in 1999 for a study where nurses in the state of Pennsylvania (USA) were surveyed about their work setting. The current study used a sample of the original 1999 data and analysed the data with a focus on what the survey data could reveal about unmet nursing care needs, a predefined nursing care quality indicator and nurses reports of adverse events (i.e. medication errors; nosocomial infections and falls). The institutional review board of the University of Pennsylvania approved the conduct of this study.

## Sample

**Hospitals**—Acute care hospital organisations provided the setting for the parent study. The current study used the steps described by Aiken and colleagues (Aiken *et al.* 2002). A large fraction of nurses in the state of Pennsylvania were asked to provide information on organisational characteristics of their employing hospital. For the current study, we accessed an average of 60 nurse respondents from 168 of the original 210 hospitals completed the 1999 survey; half of the sample hospitals reviewed for the current study had more than 50 nurse respondents, and >80% of the hospitals had more than 25 nurse respondents.

**Nurses**—In the parent study, a 50% random sample of nurses who resided in Pennsylvania and listed on the rolls of the Pennsylvania State Board of Nursing were mailed a survey to their homes. Surveys were returned by 42,000 nurses yielding a 52% response rate, an average of 200 nurses per each of the 210 general hospitals operating in Pennsylvania in 1999. The procedures used to identify nurses for the current study is described elsewhere (Aiken *et al.* 2002). The current study included nurses from an array of nursing unit types and reflects a reality that patients often receive nursing care in multiple specialty areas in a hospital (Aiken *et al.* 2002). The analyses in the current study were performed on a sample of 10,184 nurses who worked in 168 acute care hospitals in Pennsylvania.

**Patients**—The focus of the parent study and the current study was on a group of general, vascular and orthopaedic surgical patients ( $n = 232,342$ ). The three groups of surgical patients are described elsewhere (Aiken *et al.* 2002). The Pennsylvania Health Care Cost Containment Council (PHC4) data file for adults hospitalised between 1998–1999 provided information about the target patient population. Only patient episodes with the age delimiter of 20–85 were included in this study.

## Measures

A list of the concepts, study and control variables and data sources for this investigation are described in Table 1.

**Care environment**—Nurse staffing was measured as the number of patients, between 1–20, cared for by nurses on their last shift worked. Values were aggregated to the hospital level, resulting in a mean number of patients cared for by nurses in a hospital. The educational composition of each hospital's nursing staff was measured by the proportion of nurses who were at least baccalaureate prepared in nursing.

In the parent study, the patient care environment was measured by the Practice Environment Scale of the Nursing Work Index (PES-NWI) (Lake 2002). Questionnaire items are intended to reflect agreement (i.e. 1 = strongly disagree, 2 = somewhat disagree, 3 = somewhat agree and 4 = strongly agree) to whether a characteristic of the organisation is present in the practice environment. The nurse practice environment in hospitals is characterised using 31 items in five subscales: Nurse Participation in Hospital Affairs (e.g. 'opportunity for staff

nurses to participate in policy decisions’); Nursing Foundations for Quality of Care (e.g. ‘working with nurses who are clinically competent’); Nurse Manager Ability, Leadership and Support of Nurses (e.g. ‘a head nurse who is a good manager and leader’); Staffing and Resource Adequacy (e.g. ‘enough registered nurses to provide quality patient care’); and Collegial Nurse–Physician Relations (e.g. ‘a lot of teamwork between nurses and doctors’). All five of the subscales have satisfactory psychometric properties.

In the parent study, nurses' responses to the PES-NWI items were aggregated to calculate hospital-level means of the five PES-NWI subscales. Based on the hospital-level means of the five PES-NWI subscales, hospitals were then grouped into three categories: unfavourable nurse practice environments (scores above 2.5 on zero or one subscale), mixed practice environments (scores above 2.5 on two or three subscales) or favourable practice environments (scores above 2.5 on four or five subscales). This classification has been supported by both criterion validity and latent class analysis (Lake & Friese 2006).

The 1999 American Hospital Association Annual Survey and the 1999 Pennsylvania Department of Health Hospital Survey made available data on hospital characteristics. Hospitals were grouped into three size categories: small ( $\leq 100$  beds), medium (101–250) and large ( $\geq 251$  beds). Teaching status was measured by the ratio of resident physicians and fellows to hospital beds and grouped into three categories: non-teaching (no postgraduate trainees), minor teaching (1:4 ratio or smaller of trainees to beds) and major teaching ( $> 1:4$  ratio of trainees to beds). Hospitals with facilities for open-heart surgery and/or major transplants were classified as high technology hospitals. Finally, inpatient acute care nursing unit types were grouped into four unit types (medical/surgical, intensive care, OR/Recovery and other). The proportion of nurses who worked in each unit type was calculated as a hospital-level measure.

**Patient demographics**—Two components were considered important to this current effort: patient demographic information and acute physiological condition at the time of hospital admission. These data served to estimate risk-adjusted models that control for differences in patient characteristics across hospitals in the current study. Patient factors that were included in the predictive modelling include: race, insurance status and severity of illness. In the current study, hospital-level proportions were calculated for three racial groups (white, black and other) and four insurance status groups (public, private, no insurance and other). The Atlas severity score served as a measure of illness severity. The Atlas severity score ranges from 0 (no probability of in-hospital death) – 4 (probability  $> 0.5$  of in-hospital death) and measures the likelihood of inpatient death (Brewster *et al.* 1985). The index was rescaled and classified patients as severely ill (i.e. 3 and 4) or not severely ill (i.e. 0, 1 and 2). The proportion of patients classified as severely ill were calculated for each hospital.

**Nursing care**—The quality of nursing care was measured based on an aggregate of nurse-reported necessary nursing care left undone or unmet nursing care needs (Lucero *et al.* 2009). Nurses were asked in the parent study to select from a list of seven care activities that were necessary but left undone because they lacked the time to complete them during their last shift worked. The activities comprise nursing interventions related to the overall process of care that if left undone may compromise the quality of nursing care. The unmet nursing care needs composite measure was constructed from the original seven care needs: teach patients or family; prepare patients and families for discharge; comfort/talk with patients; adequately document nursing care; back rubs and skin care; oral hygiene; and develop or update nursing care plans.

The composite measure, unmet nursing care needs, was created as an indicator of nursing care quality given that care needs left undone could not be directly matched to individual patient outcomes (Sochalski 2004). To construct the hospital-level composite measure of unmet nursing care needs, an individual composite measure was calculated as the average count of the seven nursing care activities left undone by each nurse. Individual nurse composite measures were then aggregated for each hospital, resulting in a mean number of unmet nursing care needs per hospital. The reliability of this measure has been supported by a Cronbach's alpha coefficient of 0.73 (Lucero *et al.* 2009).

**Outcomes**—In the parent study, nurses reported how often a patient under their care received the wrong medication or dose, acquired a nosocomial infection, or had a fall with injury. These adverse events have been consistently linked to nurse staffing (Fridkin *et al.* 1996, Kovner *et al.* 2002, Unruh 2003, Krauss *et al.* 2005). In the original 1999 survey, the response categories were never, rarely, occasionally and frequently. Nurse-reported adverse events were reclassified as frequent (occasionally and frequently) and infrequent (never and rarely) in the current study to facilitate the interpretation of the predictive analysis. The proportion of nurse-reported adverse events classified as frequent was calculated for each hospital. Nurses' retrospective reports of adverse events may provide a more reliable estimate of the occurrence of adverse events compared to institutional reports (Aiken *et al.* 1997).

## Data analysis

The associations between unmet nursing care needs and the relative proportion of frequent adverse events were examined with ordinary least square multiple regression methods, which took into account patient factors and the care environment. Data were aggregated, as hospital-level analyses were performed for each adverse event. A composite measure of unmet nursing care needs was used in the analysis. Stata 9.0 was used to analyse the data. Statistical significance was set at  $p < 0.05$ .

Multivariate models were developed to reflect the relationships postulated by the conceptual model used for the study. The intent was to estimate the effect of unmet nursing care needs given the influence of patient factors (i.e. illness severity, race and insurance status) and the care environment (i.e. nurse staffing, nursing education, nursing unit type, patient care environment; and hospital bed size and teaching and technology status) in seven sequential models. Nurse-reported adverse events served as the outcome in all models. The sequence of the regression models took the following forms. The first model examined the bivariate relationship between unmet nursing care needs and the outcome. In the second model, the outcome was regressed on the cluster of patient factors. Then, in the third model, the unmet nursing care needs composite was added to the cluster of patient factors. In the fourth model, the outcome was regressed on the group of care environment variables. This was followed by a model where unmet nursing care needs was added to the group of care environment variables. In the sixth model, the outcome was regressed on both the cluster of patient factors and the group of care environment variables. The final multivariate model contained 16 independent measures (i.e. the unmet nursing care needs composite, five patient factors and 10 care environment variables).

## Results

### Demographic characteristics of nurses and patients

Registered nurses in the current study were 40 years old on average and 93% were women. The average nurse had nearly 14 years of nursing experience and 10 years of experience in their current hospital position. Almost 40% of the nurses' highest nursing degree was the



baccalaureate degree or higher followed by the diploma (35%) and the associate degree (24%). Ninety-five per cent of the nurses were permanently employed in a hospital. The average age of the patients was 59, and the majority were men and white. One out of four patients was admitted with an emergent condition. Few patients were uninsured with almost 90% of the patients covered by either private or public insurance. Severely ill patients accounted for 6.9% of all patients.

### Care environment

Hospital-level values of the nursing organisation and hospital characteristics are presented in Table 2. On average, nurses reported caring for six patients during their last shift. Based on the PES-NWI, most nurses reported that Nursing Foundations for Quality of Care and Collegial Relations between Nurses and Physicians were present in their care environment. Nurses in approximately 23% ( $n = 39$ ) of the hospitals reported working in favourable nursing practice environments, whereas in 11% ( $n = 18$ ) of the hospitals nurses reported working in unfavourable nursing practice environments. Hospitals had slightly more than one-third of their nursing workforce educated at the baccalaureate degree or higher on average, which was similar to the US National Sample Survey of Registered Nurses conducted in 2000 (Spratley *et al.* 2002). A majority of the hospitals were medium in size, 101–250 patient beds. Almost two-thirds of the hospitals were non-teaching facilities, and 72% were classified as high technology.

### Nurse-reported unmet nursing care needs and adverse events

Table 3 provides the hospital distribution of nurse-reported unmet nursing care. Forty-one per cent of nurses reported leaving developing or updating nursing care plans undone, and 12% left preparing patients and families for discharge undone on average across hospitals. In some hospitals, the proportion of nurses leaving care undone was as low as 26% for preparing patients and families for discharge to as high as 74% for developing or updating nursing care plans. A composite measure of unmet nursing care was constructed to test the association of unmet nursing care needs and adverse events. Theoretically, the composite measure would be normally distributed with a range of 0–7. Across hospitals, nurses reported leaving an average of two out of seven necessary nursing care activities undone with a range of 0.2–3.5 (Table 3). The normal distribution and variation of unmet nursing care needs is meaningful because some care needs may have been met, and other care needs may not have been perceived as necessary.

Overall, a majority of nurses reported that each of the adverse events occurred either never or rarely (Table 3). Over one-third of the nurses reported that nosocomial infections occurred occasionally or frequently. By contrast, less than one-quarter reported that patients received the wrong medication or dose and patient falls with injury occasionally or frequently. At the hospital level, there was variation in the frequent occurrence of adverse events. The proportion of nurses who reported that the three adverse events occurred occasionally or frequently ranged from 15% for medication errors to 31% for nosocomial infection.

### Effects of unmet nursing care needs on adverse events

The multivariate linear regression analysis in the current study was carried out to determine the amount of variance explained by unmet nursing care needs after taking into account sequentially patient factors, the care environment and both patient factors and the care environment. Table 4 provides the effects of unmet nursing care needs on the risk-adjusted adverse events. Unmet nursing care needs had significant effects on each adverse event. The results imply that in fully adjusted models (i.e. where unmet nursing care needs, patient factors and care environments are analysed together), an increase in unmet nursing care

needs was associated with an increase in the relative proportion of nurses' reports of frequent medication errors, nosocomial infections and patient falls with injury.

Therefore, an increase in one unmet nursing care need on average in a hospital increased the relative proportion of nurse-reported frequent medication errors, nosocomial infections and patient falls with injury from 7–9 points. While there was a mix of individual patient factors and care environment variables that had notable effects on all of the adverse events, none of the patient factors were significantly associated with patients receiving the wrong medication or dose. In the sequential regression models (not shown in Table 4) leading up to the final analysis of nosocomial infections and patient falls with injury, the unmet nursing care needs effect was not attenuated by the influence of patient factors. However, the effect of unmet nursing care needs was weakened when the care environment was taken into account in the analysis of nosocomial infections and patient falls with injury. Nearly one-third of the initial influence of unmet nursing care needs on nosocomial infections was accounted for by the care environment in the final model (Table 4).

## Discussion

This study documented considerable variation in the proportion of nurses who reported leaving necessary nursing care undone and nurse-reported adverse events. The evidence from this study suggests that unmet nursing care needs were significantly associated with adverse patient events in acute care hospitals. The relationship between unmet nursing care needs and nurse-reported adverse events persisted when accounting for patient factors and the care environment.

Based on a series of linear regression models, there was a slightly greater influence of unmet nursing care needs on the relative proportion of frequent nosocomial infections as opposed to the other adverse events. This difference may be attributable to the relative contribution that unmet nursing care needs make to explain the occurrence of these adverse events. In other words, the care activities in this study may have greater clinical relevance to nosocomial infections than with medication errors and patient falls. Few studies (Doran *et al.* 2002, Kwan *et al.* 2004) have identified a link between the quality of nursing care and adverse events. The findings from this study are the first known to link the quality of nursing care to adverse events after taking into account the care environment and patient risk factors.

The multivariate analyses revealed mixed patterns of association between patient factors and care environment variables and the study outcomes. Notably, the nursing practice environment was not associated with any of the adverse events. Favourable nursing practice environments have been linked to higher nurse-to-bed ratios (Lake & Friese 2006). The influence of the nursing practice environment may have been accounted for in the associations found between nursing unit types and the adverse events. The nursing unit type measure in this study may be a proxy of nurse staffing and resource adequacy.

The estimated increases in the percentage of nurse-reported frequent medication errors, nosocomial infections and patient falls with injury should be interpreted with caution. Same-source bias introduced by nurse-reported unmet nursing care needs and adverse events could produce relationships that would not otherwise exist in practice. However, physical and methodological separation in the parent study survey reduced same-source bias in three ways: (1) limited the saliency of any contextually provided retrieval cues, (2) reduced respondent's ability and/or motivation to use previous answers to fill in gaps in what was recalled and/or to infer missing details and (3) made prior responses less salient, available or relevant (Podsakoff *et al.* 2003).



Unmet nursing care needs may not have captured adequately the contribution of nursing care quality in hospitals, because the composite measure was restricted to seven care activities. Nurses in the original survey indicated when a task was necessary and left undone. It was impossible to know the meaning of unchecked items. It may be that nursing care needs were met or that patients did not have the need for certain care activities. It is also conceivable that some activities are necessary intermittently and not during every shift. In a recent study (Kalisch *et al.* 2009), based on the frequency of 23 care activities that were missed, 459 nurses in three hospitals reported 44% of assessment care activities and more than 70% of interventions, basic care and planning activities were missed on their unit. While the care activities in the current study were internally consistent as a whole, the question remains whether or not the overall measure of unmet nursing care needs provides a valid indicator of nursing care quality in hospitals.

There may be concerns about the time between when the original data were collected in the parent study and its current use. The data provided an opportunity to contribute to our understanding of a limited topic of research. The process of care–outcome link has demonstrated enduring relevance over time (Donabedian 1988; Donabedian 1966, 2003, 2005), and the conceptualisation of the nursing care has remained practically constant (Aydelotte & Tener 1960, Hegyvary & Haussman 1976, Lindeman *et al.* 1978, Hageman & Ventura 1981, Mitchell *et al.* 1989, Chang *et al.* 2002, Doran *et al.* 2006). There is strength in using the nurse survey data. The large number of respondents as well as the exclusive information regarding hospitals settings allows for the characterisation of a group of nurses who worked in a large number of acute care settings (i.e. 168 Pennsylvania hospitals). The proportion of nurses was equal across hospitals given the number of nurse positions in each hospital. This suggests response rates were similar across hospitals, which should theoretically mitigate any hospital response bias (Aiken *et al.* 2003).

## Conclusions

There is a significant association between the quality of nursing care and adverse events in hospitals. However, the effect of unmet nursing care needs was attenuated considerably by the care environment in the analysis of nosocomial infections. This reflects the theoretical and empirical connection between the care environment and clinical outcomes (Aiken *et al.* 2008, Friese *et al.* 2008). The findings from this study suggest that attention to the time nurses spend with patients and maximising patient care delivery could result in a reduction in the occurrence of adverse events in hospitals.

## Relevance to practice

This study provides registered nurses with evidence that their clinical actions play a significant role in the quality of patient care. Our findings suggest that the act of omitting necessary nursing care can increase adverse events in hospitalised patients. It may be common that 28% or more care overall is left undone by nurses in hospitals. This figure is concerning because nurses-reported unmet nursing care needs based on the condition that care activities were both necessary and left undone. While it is unclear whether omitting certain nursing care activities over others contributes greater relative value to the occurrence of adverse events, the occurrence of adverse events may be mitigated when nurses spend time with their patients completing necessary care activities (e.g., teaching a diabetic patient about skin care self-management). Moreover, the time spent with patients provides nurses the opportunity to identify signs and symptoms of complications that, if acted on quickly, may prevent deterioration in a patient's conditions and even adverse events.

The focus on nursing care in this paper was motivated by the assumption that high-quality patient care is not only the result of health care structures but also the capacity of nurses to execute necessary care for patients (Donabedian 1988, Maas 1998). A considerable amount of direct nursing care is performed independently by nurses based on professional practice standards and clinical judgement. Because clinical nurses may be the most knowledgeable of direct care work demands, they should be engaged with nursing management in health care quality improvement and the creation of policies on human resource allocation. Such policies might influence how hospital organisations manage human resources to reinforce and enhance nurses' awareness of the care environment, patient care delivery and nursing care quality. These policies should promote nurses vigilance in identifying unsafe situations and responding to minimise or eliminate potential harm to patients.

The quality of health care delivery is generally thought about in terms of the ability of health care providers to carry out appropriate interventions. However, for over 50 years, nurses have been concerned that the quality of care is affected by the time they spend with patients (Abdellah & Levine 1954, Buerhaus *et al.* 2005). The evidence from this study points out that a lack of time not only affects the ability to carry out necessary nursing care activities but may lead to more adverse patient events. Hospital organisations must aim to develop care environments that integrate individual and organisational behaviours which seek to continuously reduce harm to patients that results from poor nursing care quality (Lucero *et al.* 2009).

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**Table 1**  
**List of concepts, variables and data sources**

Concept	Primary variables	Secondary variables	Data source
Nursing care quality	Unmet nursing care needs		RNS
Outcome	Patient received wrong medication or dose		RNS
	Nosocomial infection		RNS
	Patient falls with injury		RNS
Care environment		Nurse staffing	RNS
		Education preparation of registered nurses	RNS
		Nurse practice environment	RNS
		Bed size	AHA
		Teaching status	AHA
		Technology status	AHA
Patient factors		Demographics	PHC4
		Physiological severity	PHC4

AHA, American Hospital Association; PHC4, Pennsylvania Health Care Cost Containment Council; RNS, Nurse Survey.

**Table 2**  
**Distribution of the nursing organization and hospital characteristics**

Characteristic	Mean (SD)	Range	n (%)	Patients n (%)
<i>Nursing</i>				
Staffing*	6.3 (1.7)	3.4–17.6		
BSN-MIX (%) <sup>†</sup>	35.0 (14.0)	0.0–0.78		
Unit type (%)				
Medical/Surgical	29.0 (11.0)	0.0–60.0		
Intensive care	18.0 (8.0)	0.0–44.0		
Operating/Recovery room	10.0 (5.0)	0.0–50.0		
Other	42.0 (12.0)	12.0–75.0		
PES-NWI <sup>‡</sup>				
Nurse participation in hospital affairs	2.3 (0.2)	1.5–2.8		
Nursing foundations for quality of care	2.8 (0.2)	2.1–3.3		
Nurse manager ability, leadership and support of nurses	2.4 (0.3)	1.3–3.2		
Staffing and resource adequacy	2.2 (0.1)	1.2–3.0		
Collegial relations between nurses and physicians	2.8 (0.2)	2.1–3.1		
PES-NWI categories				
Unfavourable practice environment			18 (10.7)	
Mixed practice environment			111 (66.1)	
Favourable practice environment			39 (23.2)	
<i>Hospital</i>				
Bed size				
≤100			41 (24.0)	16,123 (7.0)
101–250			95 (57.0)	110,510 (47.0)
≥250			32 (19.0)	105,709 (46.0)
Teaching status				
Non-teaching			107 (64.0)	99,907 (43.0)
Minor teaching			44 (26.0)	78,996 (34.0)
Major teaching			17 (10.0)	53,439 (23.0)
High technology <sup>§</sup>				
Yes			121 (72.0)	103,824 (45.0)
No			47 (28.0)	128,518 (55.0)

\* Staffing is the average number of patients per registered nurse across hospitals.

<sup>†</sup>BSN-MIX is the proportion of nurses per hospital with a baccalaureate, master or higher nursing degree.

<sup>‡</sup>PES-NWI is the Practice Environment Scale of the Nurse Work Index. Hospital practice environments were categorised based on hospital-level means of the five PES-NWI subscale scores (i.e., unfavourable: mean  $\geq 2.50$  on 0–1 subscale; mixed: mean  $\geq 2.50$  on 2–3 subscales; favourable: mean  $\geq 2.50$  on 4–5 subscales).

<sup>§</sup>High technology was defined as hospitals that had facilities for open-heart surgery, major organ transplantations or both.



**Table 3**  
**Proportion of nurse-reported unmet nursing care and adverse events across hospitals ( $n = 168$ )**

Variable	Mean (SD)	Range	Nurses (%) $n = 10,184$
<i>Unmet nursing care</i>			
Develop or update nursing care plans	41.0 (13.0)	8.0–74.0	
Comfort/talk with patients	40.0 (10.0)	7.0–69.0	
Back rubs and skin care	30.0 (13.0)	0.0–69.0	
Teach patients or family	29.0 (11.0)	0.0–67.0	
Adequately document nursing care	22.0 (9.0)	0.0–42.0	
Oral hygiene	20.0 (10.0)	0.0–66.0	
Prepare patients and families for discharge	12.0 (6.0)	0.0–26.0	
Unmet nursing care needs composite*	1.9 (0.5)	0.2–3.5	
<i>Adverse events</i>			
Patient received wrong medication or dose <sup>†</sup>	15.0 (8.0)	0.0–64.0	
Never			3815 (38.1)
Rarely			4714 (47.1)
Occasionally			1390 (13.9)
Frequently			92 (0.9)
Nosocomial infections <sup>†</sup>	31.0 (12.0)	0.0–59.0	
Never			2439 (24.7)
Rarely			4053 (41.0)
Occasionally			2766 (28.0)
Frequently			617 (6.3)
Patient falls with injury <sup>†</sup>	20.0 (10.0)	0.0–55.0	
Never			4602 (46.0)
Rarely			3467 (34.7)
Occasionally			1679 (16.8)
Frequently			252 (2.5)

The distribution of each unmet care needs is based on the proportion of nurses reporting leaving the care need(s) undone.

\* The unmet nursing care needs composite was derived from the aggregate average sum of unmet nursing care needs.

<sup>†</sup> Proportion of nurses who reported occasionally or frequently about medication errors, nosocomial infections and patient falls. Nurses may not add to  $n = 10,184$  because of missing data.

**Table 4**  
**Estimates of the effects of UNCN<sup>†</sup> on risk-adjusted adverse events (*n* = 168)<sup>\*</sup>**

Variable	Wrong medication or dose		Nosocomial infection		Patient falls with injury	
	b	SE	b	SE	b	SE
UNCN	0.07 <sup>c</sup>	0.02	0.09 <sup>c</sup>	0.02	0.07 <sup>c</sup>	0.02
Patient factors						
Illness severity	0.20	0.26	1.32 <sup>c</sup>	0.32	0.51	0.29
Race black	-0.08	0.04	0.03	0.05	-0.05 <sup>a</sup>	0.05
Race other	-0.03	0.02	0.01	0.03	-0.05	0.03
Public insurance	-0.02	0.06	-0.05	0.07	0.04	0.06
Private insurance	-0.06	0.06	0.03	0.07	-0.01	0.07
No insurance	-0.04	0.19	-0.49 <sup>a</sup>	0.23	-0.33	0.21
Care environment						
Nurse staffing <sup>‡</sup>	-0.01	0.00	0.00	0.01	0.01	0.00
BSN-Mix <sup>§</sup>	-0.01	0.05	0.00	0.06	-0.01	0.06
Medical surgical unit	0.00	0.07	0.20 <sup>a</sup>	0.08	0.20 <sup>b</sup>	0.08
Intensive care unit	-0.04	0.09	0.30 <sup>b</sup>	0.10	-0.06	0.09
Operating/recovery unit	-0.28 <sup>a</sup>	0.13	-0.14	0.15	-0.21	0.14
Environment favourable	0.00	0.02	0.00	0.03	-0.01	0.03
Environment mixed	-0.02	0.02	-0.01	0.02	0.00	0.02
Hospital bed size	0.00	0.01	0.02	0.02	0.01	0.01
Hospital teaching status	0.00	0.01	0.03 <sup>a</sup>	0.01	-0.03	0.01
High technology	0.00	0.02	-0.03	0.02	0.00	0.02
Adjusted R <sup>2</sup>	0.23		0.53		0.41	

<sup>\*</sup> Beta coefficients indicate the change in the proportion of nurse-reported adverse events associated with an increase of one unmet nursing care need on average in a hospital.

<sup>†</sup> UNCN is unmet nursing care needs.

<sup>‡</sup> Nurse Staffing is the average number of patients per nurse across hospitals.

<sup>§</sup> BSN-MIX is the proportion of nurses per hospital with a baccalaureate, master or higher nursing degree.

<sup>a</sup>  $p < 0.05$ ,

<sup>b</sup>  $p < 0.01$ ,

<sup>c</sup>  $p < 0.001$ .