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Hospital Staff Nurses' Shift Length Associated With Safety and Quality of Care

Amy Witkoski Stimpfel, PhD, RN and Linda H. Aiken, PhD, RN, FAAN

Center for Health Outcomes and Policy Research, University of Pennsylvania School of Nursing, Philadelphia

Abstract

The objective of this study was to analyze hospital staff nurses' shift length, scheduling characteristics, and nurse reported safety and quality. A secondary analysis of a large nurse survey linked with hospital administrative data was conducted. More than 22 000 registered nurses' reports of shift length and scheduling characteristics were examined. Extended shift lengths were associated with higher odds of reporting poor quality and safety. Policies aimed at reducing the use of extended shifts may be advisable.

Keywords

hospitals; quality of care; registered nurses; safety; shift length

Registered Nurses' (RN) work patterns have garnered much interest over the past 15 years, especially as mounting evidence points to long hours as a contributor to poor patient outcomes such as errors and infections and poor nurse outcomes such as musculoskeletal and needlestick injuries.¹⁻⁹ This body of research has motivated some organizations, including the American Nurses Association and the Institute of Medicine (IOM), to support prohibition of mandatory overtime in an attempt to reduce extended work hours.^{9,10} Although legislative efforts have increased awareness of nurses' long work hours, less has been done to inform nursing administrators about how to manage their staff's shift length and overall work hours.

There is a dearth of large-scale data available for managers to identify and compare trends in nurses' shift lengths, scheduling patterns, and characteristics, including break opportunities. This is a salient topic for health care administrators and nurse managers because nurses' shift length and preferences regarding scheduling may influence patient safety and quality outcomes. Understanding what types of shifts nurses are working and under what conditions they are working long hours will enable systemic changes related to nurses' work hours within an organization to optimize patient care.

Nurses are well suited to report on quality due to their integral role in patient care and have been shown to be valid informants of hospital quality.¹¹ Other modifiable conditions of the nurses' work environment, such as nurses' workload, have been related to nurse assessed quality of care.¹² However, there have not been any extensive studies examining shift length with nurse-reported outcomes related to patient care quality or safety. This study takes

advantage of unique data from a large nurse survey to fill the gaps in the literature by achieving 2 principal aims: first, to provide new information on hospital nurses' shift length and scheduling characteristics and second, to estimate the effects of shift length on nurse reports of hospital safety grade and quality of care.

METHODS

Data

This study used a secondary analysis approach with observational, cross-sectional nurse survey data and administrative hospital data. Two linked data sources were used: the 2005-2008 Multi-State Nursing Care and Patient Safety Study (referred to as the "nurse survey" hereafter)¹³ and the 2006 American Hospital Association's Annual Survey of Hospitals.¹⁴ The nurse survey queried participants on shift length, demographics, scheduling characteristics, work break patterns, characteristics of the work environment, and perceptions of quality of care and safety within their hospital. The American Hospital Association survey included data on hospital characteristics such as teaching status and bed size. Further details regarding the parent study are published elsewhere.¹³ Institutional review board approval was obtained from the researchers' institution.

Sample

The analytic sample included 22 275 hospital staff RNs from 577 nonfederal acute care hospitals in 4 states (California, New Jersey, Pennsylvania, and Florida). There were at least 10 nurses per hospital, ranging from 10 to 205, with an average of 39 nurse respondents per hospital. The nurses included in this sample reported working between 1 and 24 hours on their last shift and caring for 1 to 19 patients from a variety of inpatient medical-surgical units, excluding long-term care and operating room settings. Only direct care nurses were studied.

Measurement

Nurses were asked to report the duration of their last shift by the shift's start time and end time, using whole hours. The difference between these times was used to derive the measure of shift length and was grouped into 1 of 4 shift categories: 8 to 9, 10 to 11, 12 to 13, or more than 13 hours. The 4 categories were created on the basis of common scheduling practices in the acute care setting, with the 8 and 12 hour shifts the most widespread. To account for change of shift activities, such as giving patient report, a range of hours was used.

Information regarding scheduling was examined using items from the nurse survey such as "Flexible or modified work schedules are available," "Staff nurses actively participate in developing their own schedules," and "How satisfied are you with your work schedule?" Work breaks were assessed from the nurse survey item "I am able to take at least a 30-minute break during the workday." Four-point Likert-type scale responses ranged from "strongly agree" to "strongly disagree" for all of the items. Responses "strongly disagree" and "disagree" were collapsed to form a dichotomous outcome of "disagree" for analysis purposes.

The overall quality of nursing care was measured by the question in the nurse survey "How would you describe the quality of nursing care delivered to patients in your unit?" with responses on a 4-point Likert-type scale ranging from "excellent" to "poor." Responses of "fair" or "poor" were combined, and "good" and "excellent" were combined to create a dichotomous outcome of quality. Similarly, the overall unit safety grade was measured using a 5-point Likert-type scale, with responses ranging from "A" (excellent) to "F" (failing).

This item was based on the Agency for Healthcare Research and Quality's Hospital Survey on Patient Safety Culture.¹⁵ Single-item measures of nursing care quality, such as the ones in this study, have been used in previous research both domestically¹² and internationally.^{16,17} Grades of A and B were combined, whereas grades of C, D, or F were combined to form a dichotomous outcome representing safety grade.

Multiple variables were used to control for potential confounds in the predictive models. Individual nurses' age, gender, and unit specialty (intensive care unit [ICU] vs general care) were derived from the nurse survey. The work environment and average patient-to-nurse were also derived from the nurse survey. The Practice Environment Scale of the Nursing Work Index, a widely used and validated tool, was used to measure the quality of the professional practice environment.¹⁸ Nurses' reports of the number of patients and nurses on their unit were averaged and aggregated to create a hospital-level patient-to-nurse ratio. Hospital structural characteristics were derived from the American Hospital Association's Annual Survey. Three characteristics were used: teaching status, level of technology, and bed size. Hospitals without medical residents were classified as nonteaching, hospitals that had a 1:4 ratio of residents to patients were classified as minor teaching, and hospitals with a ratio of residents to beds exceeding 1:4 was classified as major teaching. Hospitals with the technology to complete either open-heart surgery or major organ transplant surgery were classified as high technology. The hospitals were separated into 3 categories on the basis of the number of licensed beds, with fewer than 100 beds classified as small, 100 to 250 classified as medium, and more than 250 classified as large.

Data analysis

Descriptive and inferential statistics were calculated, examining shift length in detail by individual nurse and then by hospital specialty unit and state. Differences were assessed using analysis of variance for continuous variables accounting for multiple comparisons, and ² tests for categorical variables. Generalized estimating equation models were used to assess the relationship between shift length and nurse-reported safety and quality measures, which accounted for the nonindependence of the nurses within hospitals. Bivariate generalized estimating equation models were constructed prior to multivariate generalized estimating equation models, which accounted for nurse, nursing organizational, and hospital structural characteristics (as described earlier). The 8- to 9-hour shift length was the reference group for all of the predictive models. All statistical analyses were conducted using SAS version 9.2 (SAS Institute, Cary, North Carolina), and significance was set at the $P < .05$ level.

RESULTS

Characteristics of sample

The demographics of the nurses in this study closely resemble the national average of RNs according to the 2008 National Sample Survey of Registered Nurses.¹⁹ Most of the nurses were non-Latino ($n = 20\,627$, 95%), white ($n = 16\,521$, 74%), and female ($n = 20\,644$, 93%) and were on average 44 years old. Fewer than half of the nurses held a baccalaureate degree in nursing ($n = 9165$, 41%). More than half of the nurses in this sample worked in high-technology hospitals with some teaching capacity, and most had more than 100 beds.

Shift length by individual nurse, hospital unit specialty, and state

The most common shift length category was 12 to 13 hours ($n = 14\,370$, 65%). About a quarter ($n = 5677$, 26%) of the nurses in the sample worked 8 to 9 hours, and the rest of the nurses were almost evenly split between 10 to 11 hours ($n = 904$, 4%) and more than 13 hours ($n = 991$, 5%). Regardless of shift length, however, the majority of the nurses reported

being satisfied with their schedule, developing their own work schedule, and having a flexible work schedule available. These results are shown in Table 1 in addition to results of comparisons between nurses who reported working in 1 of 3 types of ICUs (pediatric, neonatal, or adult) or a non-ICU setting (eg, medical-surgical). Using a χ^2 test, there was a significant difference in shift length by unit specialty ($P < .0001$). About 80% ($n = 4604$) of ICU nurses and about two-thirds ($n = 9522$, 60%) of non-ICU nurses reported working 12 to 13 hours on their last shift. More non-ICU nurses worked 8 to 9 hours ($n = 4796$, 30%) than ICU nurses ($n = 825$, 14%); however, both ICU and non-ICU nurses worked shifts beyond 13 hours in roughly the same proportion, 5% ($n = 258$) and 4% ($n = 690$), respectively. Also displayed in Table 1 are comparisons of nurse reports of quality and safety grade by unit specialty. We found that nurses working in general patient care settings reported poor quality and safety grade with greater frequency than nurses working in ICU settings.

There was notable variation in nurses' reports of scheduling practices and preferences by state, specifically, regarding work breaks. As displayed in the top of Table 2, 74% ($n = 5187$) of California nurses responded that they *strongly* or *somewhat agreed* that they were able to take a 30-minute break most days. In comparison, only about half (51%) or fewer nurses reported that they *strongly* or *somewhat agreed* that they took a break most days in the other states.

Shift characteristics are shown in the bottom portion of Table 2. A one-way analysis of variance indicated that the average shift length differed by state ($P < .05$), with a post hoc Tukey test for multiple comparisons, indicating that all of the pairwise comparisons were significantly different. Pennsylvania nurses had the shortest average shift length of 10.7 hours, whereas California nurses had the lowest percentage of shifts worked beyond 13 hours (1.74%). Conversely, nurses from Florida reported the longest average shift length at 12.1 hours and also had the highest percentage of nurses working beyond 13 hours (9.35%). Despite disparate average shift lengths across states, the median shift length was 12 hours for all states. Finally, we found that average patient-to-nurse ratios ranged from 4 to 6 patients per nurse, with California having the lowest patient-to-nurse ratio.

Nurses' shift length and nurse-reported quality and safety

Nurses' shift length was significantly associated with nurse-reported quality and safety measures. The odds of nurses reporting a poor hospital safety grade were greater for nurses in all 3 shift length categories of 10 hours or longer than for nurses in the 8- to 9-hour shift category. Similarly, shift lengths of 10 hours or longer were associated with greater odds of nurses' reporting that "the quality of nursing care is fair or poor" on their unit than nurses who worked 8-to 9-hours. Shift length remained a significant predictor of nurse-reported quality and safety even after adjusting for nurses' demographics (eg, age, gender), nursing organizational features (eg, staffing, practice environment), and hospital structural characteristics (eg, bed size). Both unadjusted and fully adjusted results are displayed for each of the shift length categories in Table 3.

DISCUSSION

We found that the odds of reporting poor quality of care and a poor safety grade were increased for nurses working shifts of 10 hours or longer compared with nurses working 8 to 9 hours. Notably, odds were the highest, more than 2-fold higher, for the nurses working the longest shifts. Although many nurses report to be satisfied with longer shift lengths, these results suggest that there may be adverse implications of long shifts for quality and safety of care. These findings contribute new measures, nurse-reported safety and quality, to the growing body of research associating long work hours with deleterious outcomes. Although

we used nurse-level data, the implications of our findings are applicable at the hospital or organizational level in addition to the individual nurse.

The 2003 IOM report *Keeping Patients Safe* recommended that nurses not work beyond 12 hours per day to minimize fatigue and improve patient safety.¹⁰ Our data are limited to shift length in whole hours, so we cannot evaluate this recommendation precisely. We can show, however, that only 43% or 248 of hospitals had all nurse respondents reporting that they worked fewer than 13 hours on their last shift. This finding suggests that uptake of the IOM recommendation has not been widespread despite efforts by the IOM and other organizations, such as the American Nurses Association, that have endorsed this recommendation.²⁰

We analyzed nurses' responses regarding break opportunities during the work day, by states with and without laws protecting workers' meal/rest breaks. During the study period, California was the only state that protected workers' work breaks and rest periods through legislation.²¹ Registered nurses working in California for 6 hours or longer are entitled to a 30-minute meal break, with an additional 30-minute meal break if working beyond 8 hours. Employees are also allotted a 10-minute break for every 4 hours worked.²¹ As expected, California had the highest percentage of nurses who reported being able to take a 30-minute break on most shifts (74%). Adequate staffing levels may have an impact on the ability of a nurse to take the allotted break time. Indeed, California had the best staffing, with nurses in California caring for 1 fewer patient on average than nurses in Pennsylvania and New Jersey.²² We also found a significant association between staffing and breaks. Although multifactorial in nature, it is likely that the combination of the legislation and adequate staffing levels was effective in encouraging the nurses in California to take a break on most shifts.

This study confirms that many nurses do not regularly taking breaks during the workday. Breaks may not only play an essential role for the productivity and well-being of the nurse, but the length of breaks also may have an effect on patient safety. Rogers, Hwang and Scott⁶ showed that a lack of a break alone was not associated with an increased risk for errors, but nurses who took longer breaks (by as little as 10 minutes) had a 10% decrease in the odds of making an error. Nurse managers are vital to planning and enforcing staff breaks by communicating to staff about the importance of breaks, scheduling breaks during meal times, and providing staff to cover patients while nurses are away from the unit.²³

In addition, nurse managers may find it beneficial, from a safety perspective, to consider their unit type when handling scheduling and shift length issues. Our results showed differences in shift length by specialty unit, with 80% of ICU nurses working 12 to 13 hours compared with 60% of general care unit nurses. Given the higher acuity, increased complexity, and vulnerability of critically ill patients, it is concerning that 8 in 10 ICU nurses worked 12 to 13 hours, as we found nurses working 12 hours or longer reported a lower safety grade and poorer quality than nurses working shorter shifts.

We also found small differences in flexibility of schedules and participation in scheduling by ICU and non-ICU nurses, although regardless of unit type, most nurses were satisfied with these scheduling characteristics. Maintaining a flexible range of scheduling options has proven successful in retaining staff and recruiting nurses to reenter the workplace. For example, the Cleveland Clinic has implemented a "Parent Shift" program that allows experienced nurses with young children to work during the school day in 2- to 6-hour shifts. The benefits of program such as this one include reduced agency nurse and overtime use while potentially attracting nurses back to the profession.²⁴ Further research is needed to clarify what impact flexible schedules have on patient safety and nurse outcomes.

Limitations

As a secondary analysis of cross-sectional data, our results imply association, not causation. Using a longitudinal design in the future could enable researchers to assess a causal relationship between shift length and quality. We took advantage of existing data; however, future studies could obtain additional detail on variables such as overtime and whether the nurses held multiple jobs. Our sample is limited to 4 states, although together they account for approximately 25% of the US population,²⁵ representing a large and demographically diverse portion of the country. We used nurse-assessed quality and safety measures. However, other related research has demonstrated that nurse-assessed patient outcomes closely reflect patient rating of their hospitals¹⁷ and clinical patient outcomes from independent sources.²⁶

CONCLUSION

Most hospital staff nurses work extended hours, with most working at least 12 consecutive hours. These long hours may be impacting patient safety and quality. This study found that nurses working shifts of 10 hours or longer were associated with worse reports of patient care quality and overall safety grade compared with nurses working 8 to 9 hours. These findings add to a growing body of research, which suggests that a reevaluation of widespread extended nurse shift length may be warranted.

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Table 1

Nurses' Reports of Scheduling Practices and Nurse Reported Quality and Safety by Unit Specialty and Combined^a

	Non-ICU (n = 16 074)	ICU (n = 5 831)
Scheduling Practice	n (%)	n (%)
Shift length of last shift worked		
8-9 h	4 796 (30)	825 (14)
10-11 h	786 (5)	96 (2)
12-13 h	9 522 (60)	4 604 (80)
>13 h	690 (4)	258 (5)
I am able to take at least a 30-min break during the workday		
Strongly/somewhat disagree	7 277 (46)	2 295 (40)
Strongly/somewhat agree	8 426 (54)	3 408 (60)
Flexible or modified work schedules are available		
Strongly/somewhat disagree	4 706 (30)	1 562 (27)
Strongly/somewhat agree	11 066 (70)	4 162 (73)
Staff nurses actively participate in developing their own schedules		
Strongly/somewhat disagree	4 264 (27)	1 058 (19)
Strongly/somewhat agree	11 478 (73)	4 653 (81)
Satisfied with schedule		
Strongly/somewhat disagree	2 208 (14)	725 (13)
Strongly/somewhat agree	13 746 (86)	5 066 (87)
Quality and safety		
Poor quality of care	2 655 (19)	643 (12)
Poor safety grade	5 202 (36)	1 469 (28)

Abbreviation: ICU, intensive care unit.

^aPercentages may not add to 100 due to rounding or total to 22 275 due to missing data. All ² tests between scheduling items in ICU and non-ICU nurses were significant at the $P < .001$ level.

Table 2

Nurses' Reports of Scheduling Practices and Shift Characteristics by State

	California (n = 7198)	New Jersey (n = 4863)	Pennsylvania (n = 5536)	Florida (n = 4858)
Scheduling Practice	n (%)	n (%)	n (%)	n (%)
I am able to take at least a 30-min break during the workday				
Strongly/somewhat disagree	1828 (26)	2375 (52)	3167 (59)	2376 (50)
Strongly/somewhat agree	5187 (74)	2188 (48)	2221 (41)	2424 (51)
Flexible or modified work schedules are available				
Strongly/somewhat disagree	2064 (29)	1393 (30)	1638 (30)	1275 (27)
Strongly/somewhat agree	4963 (71)	3193 (70)	3787 (70)	3545 (74)
Staff nurses actively participate in developing their own schedules				
Strongly/somewhat disagree	1817 (26)	1161 (25)	1450 (27)	988 (20)
Strongly/somewhat agree	5199 (74)	3410 (75)	3952 (73)	3837 (80)
Satisfied with work schedule				
Strongly/somewhat disagree	726 (10)	636 (14)	1066 (19)	561 (12)
Strongly/somewhat agree	6416 (90)	3998 (86)	4439 (81)	4269 (88)
Shift characteristic				
Shift length, mean ^a (SD)	11.2 (2)	11.43 (2)	10.7 (2.2)	12.1 (1.65)
Shift length, median	12	12	12	12
Shifts >13 h (%)	1.74	4.91	3.29	9.35
Patient-to-nurse ratio, mean	4	5	5	6
Number of hospitals	224	72	134	147

^aMean shift length was significantly different by state using analysis of variance with the Tukey test for multiple comparisons $P < .05$. Percentages may not add to 100 due to rounding.

Table 3

Odds Ratios Showing Relationship Between Nurses' Shift Length and Nurse-Reported Safety and Quality of Care

Outcome	Unadjusted			Fully Adjusted ^a		
	OR	95% CI	P	OR	95% CI	P
<i>Poor hospital safety grade</i>						
8- to 9-h shift (reference category)						
10- to 11-h shift	1.36	1.17-1.59	<.0001	1.32	1.12-1.55	.001
12- to 13-h shift	1.18	1.08-1.28	.0001	1.21	1.11-1.31	<.0001
>13-h shift	2.38	2.03-2.79	<.0001	2.25	1.89-2.68	<.0001
<i>Poor quality of nursing care</i>						
8- to 9-h shift (reference category)						
10- to 11-h shift	1.48	1.22-1.80	<.0001	1.41	1.14-1.74	.0013
12- to 13-h shift	1.26	1.12-1.41	<.0001	1.27	1.13-1.41	<.0001
> 13-h shift	2.69	2.27-3.18	<.0001	2.43	2.04-2.89	<.0001

Abbreviations: CI, confidence interval; OR, odds ratio.

^aFully adjusted models account for nurse age, gender, unit specialty, staffing, practice environment, hospital bed size, technology available, and teaching status. The practice environment was derived from the Practice Environment Scale of the Nursing Work Index.