

The Working Hours Of Hospital Staff Nurses And Patient Safety

Both errors and near errors are more likely to occur when hospital staff nurses work twelve or more hours at a stretch.

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ABSTRACT: The use of extended work shifts and overtime has escalated as hospitals cope with a shortage of registered nurses (RNs). Little is known, however, about the prevalence of these extended work periods and their effects on patient safety. Logbooks completed by 393 hospital staff nurses revealed that participants usually worked longer than scheduled and that approximately 40 percent of the 5,317 work shifts they logged exceeded twelve hours. The risks of making an error were significantly increased when work shifts were longer than twelve hours, when nurses worked overtime, or when they worked more than forty hours per week.

SEVERAL TRENDS IN HOSPITAL USE and staffing patterns have converged to create potentially hazardous conditions for patient safety. High patient acuity levels, coupled with rapid admission and discharge cycles and a shortage of nurses, pose serious challenges for the delivery of safe and effective nursing care for hospitalized patients.¹ While systematic national data on trends in the number of hours worked per day by nurses are lacking, anecdotal reports suggest that hospital staff nurses are working longer hours with few breaks and often little time for recovery between shifts.² Scheduled shifts may be eight, twelve, or even sixteen hours long and may not follow the traditional pattern of day, evening, and night shifts. Although twelve-hour shifts usually start at 7 p.m. and end at 7 a.m., some start at 3 a.m. and end at 3 p.m. Nurses working on specialized units such as

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surgery, dialysis, and intensive care are often required to be available to work extra hours (on call), in addition to working their regularly scheduled shifts. Twenty-four-hour shifts are becoming more common, particularly in emergency rooms and on units where nurses self-schedule.

No state or federal regulations restrict the number of hours a nurse may voluntarily work in twenty-four hours or in a seven-day period.³ Even though state legislatures in approximately nineteen states have considered bans on mandatory overtime for nurses and other health care professionals, bills prohibiting mandatory overtime for nurses have passed only in California, Maine, New Jersey, and Oregon. No measure, either proposed or enacted, addresses how long nurses may work voluntarily.⁴ The recent Institute of Medicine (IOM) report, *Keeping Patients Safe*, explicitly recommends that voluntary overtime also be limited.⁵

The well-documented hazards associated with sleep-deprived resident physicians have influenced changes in house staff rotation policies.⁶ In contrast, although shift-working nurses have been the focus of numerous studies, it is not known if the long hours they work have an adverse effect on patient safety in hospitals.⁷ The purpose of this paper is to examine the work patterns of hospital staff nurses and to determine if there is a relationship between hours worked and the frequency of errors.

Study Data And Methods

■ **Sample.** A cover letter explaining the study and eligibility criteria was mailed to a random nationwide sample of 4,320 members of the American Nurses Association (ANA) during the winter of 2002; 1,725 nurses expressed interest by returning their completed demographic questionnaire to the Survey Research Institute at Temple University in Philadelphia. Two logbooks covering a two-week period each, instructions for completing the logbooks, and postage-paid envelopes were mailed to 891 eligible subjects (unit-based hospital staff nurses working full time). Three hundred sixty-two subjects returned both logbooks, and thirty-one completed only one of the two logbooks, for a return rate of approximately 40 percent. The Institutional Review Board at the University of Pennsylvania approved this study, and subjects were paid \$140 for their participation.

■ **Subjects.** The sample of 393 registered nurses (RNs) was predominantly female (92 percent), Caucasian (79 percent), middle-aged (mean age 44.8 ±8.8 years, range 22–66), and experienced (mean 17.2 ±10.0 years). Only 26.3 percent of the participants reported less than ten years' experience, while 41.9 percent reported twenty or more years. All participants worked full time (at least thirty-six hours per week) as hospital staff nurses. Half reported working in hospitals with more than 300 beds; only 11 percent reported working in a hospital with less than 100 beds. The majority of participants were employed at hospitals located in urban (56 percent) or suburban (19 percent) areas. The remaining participants worked in hospitals located in small towns (18 percent) or rural areas (7 percent). The characteristics of

nurses in the study sample did not differ significantly from those of nurses in the 2000 National Sample Survey of Registered Nurses (NSSRN) in terms of sex, age, marital status, and work environment (hospital size, urban/rural location, and type of hospital unit).⁸ Our sample has slightly more nurses who identified their ethnicity as Asian (10.7 percent) than among participants in the NSSRN (3.8 percent).

■ **Instruments.** Spiral-bound logbooks were used to collect information about hours worked (both scheduled and actual hours), time of day worked, overtime, days off, and sleep/wake patterns. Subjects completed seventeen to forty items per day; all forty questions were completed only on days the nurses worked. Questions regarding errors and near errors were included, and space was provided for nurses to describe any errors or near errors that might have occurred during their work periods. On days off, nurses were asked to complete the first seventeen questions about their sleep/wake patterns, mood, and caffeine intake. All items in the logbook and the logbook format itself were pilot-tested before this study began.

Logbooks (both paper and electronic) have been used to collect data during field studies of pilots' cockpit alertness for more than ten years, and from various other groups of subjects including air traffic controllers, flight controllers during space shuttle missions, and emergency room physicians.⁹ Data recorded about sleep patterns in these logbooks compare well with data recorded using objective measures such as wrist actigraphy or ambulatory polysomnography.¹⁰

Although logbooks are not often used to collect information about medical errors, there is some evidence that daily, anonymous, end-of-shift reporting of errors in a logbook is a valid approach to ascertaining the nature and prevalence of nursing errors. During a one-month study period of medication errors at a large military hospital, nurses completed formal incident reports on only 6 percent of the medication errors and 15 percent of the near errors that they reported using daily, anonymous coupons.¹¹ Another study found that resident physicians also were more likely to report potential injuries to patients using a confidential e-mail system with daily prompts about reporting than they were to complete traditional incident reports.¹²

■ **Analysis.** Data from demographic questionnaires and logbooks were summarized using descriptive statistics and frequency tables. The duration of scheduled and actual work hours per shift was calculated and aggregated per nurse and per week. Cutpoints for classifying shift durations were chosen as 8.5 hours and 12.5 hours because "eight-hour" and "twelve-hour" shifts are usually scheduled to allow for a half-hour handover period at the end of the shift. A work shift was classified as an overtime shift if the actual work hours were longer than the scheduled hours or if the nurse reported that the shift was "scheduled overtime."

A binary response for making an error during a worked shift was used as the primary outcome in analyses. When a nurse caught him/herself before making an error during a shift, a binary near-error variable was reported and treated as the secondary outcome. Errors and near errors were codified into categories by study

investigators, based on the descriptions provided in logbooks (for example, medication administration, procedural, transcription). The univariate associations between the risk of making an error or a near error and (1) the actual duration of the shift, and (2) overtime were estimated separately using logistic regression models. The effect of overtime was also examined by stratifying shifts by their expected duration. Since multiple work shifts from the same nurse contributed to this analysis, procedures based on Generalized Estimating Equation (GEE) were used to determine the odds ratio (OR) while accounting for the nonindependence between repeated measurements.¹³ Significance tests were two-sided with alpha = .05. Multivariate analyses also were conducted to evaluate the adjusted associations between errors (or near errors), work hours, and overtime, while controlling for other variables including age, hospital size, and type of hospital unit. For the week-level data, logistic regression models were performed to assess if working more than forty hours or fifty hours would increase the probability of making one or more errors (or near errors) in a week.

Study Results

Data collected on 5,317 work shifts revealed that hospital staff nurses worked longer than scheduled daily, and generally worked more than forty hours per week. Half of the shifts worked exceeded ten and a half hours. Although 31 percent of the scheduled shifts were scheduled for durations greater than or equal to 12.5 hours, there were 2,057 shifts (39 percent) where nurses worked at least 12.5 consecutive hours (Exhibit 1). Fourteen percent of the respondents reported working sixteen or more consecutive hours at least once during the four-week pe-

EXHIBIT 1
Description Of Work Patterns Of Full-Time Hospital Staff Nurses, 2002

Variable	Number of shifts	Percent
Number of shifts	5,317	100.0
Scheduled shifts ^a		
Up to 8.5 hours	2,452	46.6
8.5–12.5 hours	1,183	22.5
12.5 or more hours	1,623	30.9
Actual shifts ^b		
Up to 8.5 hours	771	14.5
8.5–12.5 hours	2,484	46.8
12.5 or more hours	2,057	38.7
Number of overtime shifts	4,292	81.4
Number of mandatory overtime shifts	360	6.8

SOURCE: Authors' analysis of survey results.

^a Scheduled shift hours were missing from 59 shifts. Mean length (hours): 10.3 (standard deviation, ±2.3); range: 1.0–22.5 hours.

^b Actual work hours were missing from 5 shifts. Mean length (hours): 10.8 (SD, ±2.5); range: 1.2–23.7 hours.

riod. The longest shift worked was twenty-three hours, forty minutes.

Nurses reported leaving work at the end of their scheduled shift less than 20 percent of the time during the study period. Although overtime was reported at the end of all types of shifts, the proportion of shifts involving overtime was significantly higher ($p = .0001$) when eight-hour shifts (85 percent) were compared to shifts scheduled for eight to twelve hours (79 percent) and twelve hours or longer (78 percent). Overall, our participants worked, on average, fifty-five minutes longer than scheduled each day, and all participants worked beyond their scheduled work shift (overtime) at least once during the twenty-eight-day data-gathering period. Almost two-thirds of the nurses worked overtime ten or more times during that period, and a third reported working overtime each day they worked during that period. There were 360 shifts where nurses reported being mandated to work overtime and another 143 shifts where they described being “coerced” to work voluntary overtime. Even though nurses worked approximately four days per week, averaging 40.2 (± 12.9) hours per week (range 8–97.2 hours per week), one-quarter worked more than fifty hours per week for two or more weeks of the four-week period.

There were 199 errors and 213 near errors reported during the data-gathering period. More than half of the errors (58 percent) and near errors (56 percent) involved medication administration. Other errors included procedural errors (18 percent), charting errors (12 percent), and transcription errors (7 percent). Approximately 6 percent of the errors and 29 percent of the near errors reported lacked sufficient information for categorization. Thirty percent of the nurses reported making at least one error, and 32 percent reported at least one near error. One nurse reported eight errors, while another nurse reported nine near errors.

Our analysis showed that work duration, overtime, and number of hours worked per week had significant effects on errors. The likelihood of making an error increased with longer work hours and was three times higher when nurses worked shifts lasting of 12.5 hours or more (odds ratio = 3.29, $p = .001$) (Exhibit 2). Working overtime increased the odds of making at least one error, regardless of how long the shift was originally scheduled (OR = 2.06, $p = .0005$). Our data also

EXHIBIT 2
Association Of Errors Or Near Errors With Nurses’ Work Duration, 2002

Work duration (hours)	Number of shifts	Shifts with one or more errors			Shifts with one or more near errors		
		Number	Percent	OR (p value)	Number	Percent	OR (p value)
Up to 8.5	771	12	1.6	1.00	20	2.6	1.00
8.5–12.5	2,484	77	3.1	1.85 (.06)	94	3.8	1.44 (.18)
12.5 or more	2,057	103	5.0	3.29 (.001)	97	4.7	1.80 (.04)
Total	5,312	192	3.5		211	4.0	

SOURCE: Authors’ analysis of survey results.

NOTES: Five shifts with four errors cannot be classified because of missing work durations. OR is odds ratio.

suggest that there is a trend for increasing risks when nurses work overtime after longer shifts (OR = 1.34, 1.53, and 3.26 for scheduled eight-hour, eight-to-twelve-hour, and twelve-hour shifts, respectively), with the risks being significantly elevated for overtime following a twelve-hour shift ($p = .005$) (Exhibit 3). Although the effects of working prolonged shifts were clearly associated with errors, there was no interaction between scheduled shift duration and overtime ($p = .17$). Finally, working more than forty hours per week and more than fifty hours per week significantly increased the risk of making an error (Exhibit 4). Results were somewhat similar for near errors (Exhibits 2–4).

Nurse and employment characteristics were also examined as potential confounders in the multivariate models. Our results suggest that the relationships of errors or near errors and work hours and overtime were not affected by age, hospital size, or type of hospital unit.

Discussion

This study represents one of the first nationwide efforts to quantify hospital staff nurse work hours and work patterns, and to determine whether extended staff nurse work hours contribute to errors and near errors. Our findings confirm that the work schedules of hospital staff nurses are unpredictably prolonged. All nurses reported working longer than scheduled at least once, and the majority reported working longer than scheduled ten times or more in a twenty-eight-day period, as well as working more than forty hours per week. Almost one-sixth of the sample reported working sixteen or more consecutive hours at least once during the period, which suggests that double shifts (or longer) are not confined to rare emergencies. Mean daily overtime durations were slightly higher than those

EXHIBIT 3
Association Of Errors Or Near Errors With Nurses' Scheduled Work Duration And Overtime, 2002

Scheduled work duration (hours)	Number of shifts	Shifts with one or more errors			Shifts with one or more near errors		
		Number	Percent	OR (p value)	Number	Percent	OR (p value)
Up to 8.5							
No OT	377	8	2.1	1.00	15	4.0	1.00
OT	2,075	65	3.1	1.34 (.42)	76	3.7	0.90 (.74)
8.5–12.5							
No OT	246	6	2.4	1.00	3	1.2	1.00
OT	937	36	3.8	1.53 (.36)	42	4.5	2.32 (.08)
12.5 or more							
No OT	360	6	1.7	1.00	8	2.2	1.00
OT	1,263	70	5.5	3.26 (.005)	67	5.3	2.34 (.03)
Total	5,258	191	3.6		211	4.0	

SOURCE: Authors' analysis of survey results.

NOTES: Fifty-nine shifts with five errors and two near errors cannot be classified because of missing scheduled work durations. OR is odds ratio. OT is overtime.

EXHIBIT 4
Association Of Errors Or Near Errors With The Number Of Hours Worked Per Week By Nurses, 2002

Hours worked	Number of weeks	Weeks with one or more errors			Weeks with one or more near errors		
		Number	Percent	OR (p value)	Number	Percent	OR (p value)
More than 40							
No	743	64	8.6	1.00	75	10.1	1.00
Yes	681	101	14.8	1.96 (<.0001)	92	13.5	1.42 (.03)
Total	1,424	165	11.6		167	11.7	
More than 50							
No	1,110	112	10.1	1.00	120	10.8	1.00
Yes	314	53	16.9	1.92 (.0001)	47	15.0	1.46 (.03)
Total	1,424	165	11.6		167	11.7	

SOURCE: Authors' analysis of survey results.

NOTE: OR is odds ratio.

reported in two small observational studies (fifty-five minutes, compared with forty-two and forty-five minutes, respectively).¹⁴

Although the occurrence of errors did not increase significantly until shift durations exceeded 12.5 hours per day, risks began to increase when shift durations exceeded 8.5 hours. Since errors are relatively rare, it is possible that this study lacked sufficient power to detect the effects of work hours or overtime on errors when nurses were scheduled to work shorter shifts (less than 12.5 hours). Certainly the trend toward increasing errors with longer work durations is consistent with other studies that have demonstrated that extended work periods are associated with increased accidents and neuropsychological deficits among nurses and have contributed to at least two hospitalwide epidemics of *Staphylococcus aureus*.¹⁵ Investigations of these epidemics showed that nurses, who were fatigued and stressed by high patient caseloads and understaffing, made frequent mistakes and procedural errors. Despite the lack of information about accident rates involving nurses, probed performance tests reveal that nurses working twelve-hour simulated shifts make more frequent errors on grammatical reasoning tasks and medical record reviewing.¹⁶

There are already hints that the fatigue associated with working twelve-hour shifts is contributing to absenteeism and job dissatisfaction among RNs. Fatigue related to length of shift or the potential of overtime at end of shift, or both, was identified as the cause of approximately 12 percent of the absences reported by a random sample of Canadian hospital staff nurses. Not only did RNs report an unusually high number of sick days year (7.4 days, compared with 3.2 for other workers), but also nurses working twelve-hour shifts reported significantly higher absenteeism rates than nurses working traditional eight-hour shifts. Nurses who worked twelve-hour shifts also expressed lower levels of job satisfaction than nurses working eight-hour shifts.¹⁷

Inasmuch as the probability of making an error because of long work hours or

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overtime was not altered significantly by the age or experience of the nurses, or by the type of unit or hospital size, other factors may be important. More specifically, physiological factors such as fatigue, system variables such as increased work intensity, or a combination of fatigue and increased work intensity may contribute to the errors and near errors we observed. It is also possible that heavy workloads themselves may increase the risk of making an error.

The use of mandatory overtime to cover staffing vacancies is a controversial and potentially dangerous practice.¹⁸ More than one-quarter of nurse participants (28.7 percent) reported working mandatory overtime at least once during the data-gathering period, a percentage that is quite similar to that reported in two surveys of more than 47,000 nurses and in a “Quick Poll” posted on the American Association of Critical Care Nurses Web site.¹⁹

Mandatory overtime is generally defined as nurses’ being told that they could be fired, be subjected to disciplinary proceedings, or lose their nursing license if they refused to stay beyond their regularly scheduled shift or come in to work on their day off.²⁰ Although not actually threatened with job loss or disciplinary proceedings, many nurses also report feeling that there will be repercussions if they refuse to work extra hours or that overtime “is voluntary but feels like it is required.”²¹ Perhaps that is why approximately 60 percent of the participants in the American Nurses Association Staffing Survey (N = 4,258) reported being “forced to work voluntary overtime.”²²

Our data are derived from the self-reports of a relatively small number of hospital staff nurses and may not be representative of the work schedules and clinical practices of other U.S. hospital nurses. However, the demographic characteristics of our nurse sample and our findings about hours worked are consistent with data reported by hospital staff nurses in the NSSRN, a probability-based sample.²³ In addition, the percentage of staff nurses who identified twelve-hour shifts as their usual shift pattern (60.6 percent) is quite similar to Marlene Kramer and Claudia Schmalenberg’s report that almost two-thirds of the 279 staff nurses they interviewed worked twelve-hour shifts.²⁴

Although our response rate was lower than that usually reported for surveys of nurses, this study required more effort than the usual survey; subjects were asked to respond to between seventeen and forty items every day for twenty-eight days.²⁵ Given the subject burden, it is possible that responders were more invested than nonresponders were in documenting a relationship between the hours they worked and effects on patient safety. However, the amounts of overtime reported varied, with some nurses indicating minimal overtime and others reporting extremely long shift durations or working more than fifty hours per week, or both.

Perhaps more important, the major unit of analysis for this study was the actual work shift (N = 5,317) rather than the nurse (N = 393).

The definition of *error* was not specified in the survey instrument. Nevertheless, all incidents described by participants were obvious deviations from current standards of practice. Reported medication errors clearly fell into the categories familiar to all nurses: wrong patient, wrong medication, wrong dose, wrong route (such as intravenous, oral), wrong time, and errors of omission.²⁶ Nurses were asked whether they made an error, not to assess whether it led to harm.

By not collecting data that could identify where participants worked, we reduced the fears usually associated with reporting errors. Studies have shown that nurses typically underreport errors because they fear repercussions, including disciplinary action by employers and regulatory agencies. As a result, only those errors considered potentially life-threatening, or approximately 5 percent of significant errors, are usually reported.²⁷ Errors that are considered “minor” or are intercepted before reaching the patient are almost never reported.²⁸ In fact, near errors are now considered nonreportable events by the Joint Commission on Accreditation of Healthcare Organizations (JCAHO).²⁹

The errors nurses reported in this study occurred in the context of well-documented deficiencies in nurses’ practice conditions in U.S. hospitals, deficiencies that nurses have been reporting for well over a decade.³⁰ The long and unpredictable hours documented here suggest a link between poor working conditions and threats to patient safety. As advocated by the IOM report on medical errors, safer patient care is more likely to result from changes in the environment in which health care is provided than from blaming health care professionals, who may be providing the best care possible under poor circumstances.³¹

Hospital staff nurses’ long hours may have adverse effects on patient care; we found that both errors and near errors are more likely to occur when hospital staff nurses work twelve or more hours. Because more than three-fourths of the shifts scheduled for twelve hours exceeded that time frame, routine use of twelve-hour shifts should be curtailed, and overtime—especially that associated with twelve-hour shifts—should be eliminated. Additional research with larger samples, inclusion of other variables such as workload and patient acuity, and more precise measurements of error is suggested.

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