Changes in nurses’ decision making during a 12-h day shift

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Key words  Controlled attention; decision-making; fatigue; patient safety; policy-capturing; shift work; stress.

Introduction

Many work environments use shift work to maintain 24-h-a-day activity, increasing the likelihood that workers will experience fatigue and sleepiness [1–3], as well as decreases in performance [1,4,5] while at work. Shift work is particularly common in health care where 24-h care is necessary. Shift work in health-care settings can adversely affect the patient and the caregiver. One study found that in nurse problems with sleep habits under shift work conditions were related to decreases in work performance [6]. Decrements in performance in doctors have also been shown under shift work conditions [7,8].

Better understanding the effects of shift work on nurses is critical for effective patient care. Nurses typically spend more time with patients than doctors, check patient status throughout their shifts and decide how to treat sudden changes in their patients. Often changes in patient status cannot wait for a physician, forcing nurses to make quick and critical decisions about patient treatment [9]. In clinical practice both doctors and nurses engage in problem-solving and decision-making activities on a daily basis [10]; however, changes in technology and specialization have increased nursing responsibilities, putting more pressure on nurses to be effective decision-makers [11]. Typically, nurses must focus on managing a wide range of information from diverse sources when making their clinical judgments [12]. However, as clinical research has only recently focused on nurses’ role in patient care, limited literature examining nurse performance and decision-making is available [13].

One area of research in health-care settings has focused on shift length. Nurses are often required to work 12-h shifts starting and ending around 7 a.m. and 7 p.m., respectively. This creates a shift work environment where
nurses never work a true ‘day’ shift, which would start around 8 or 9 a.m. and end at about 5 p.m. Instead, they work a shift that starts early in the morning, meaning they must wake early to report to work on time. Research has shown that the sleep period is shortened when working day shifts start in the early morning [14]. Furthermore, although the literature is mixed, there is growing evidence that 12-h shifts have detrimental effects on nurses’ performance [15]. For example, research has shown that nurses are more likely to experience fatigue while at work and to make a mistake if they work 12 h or more during a 24-h period [16,17]. Little research, however, has focused on nurses’ decision making when working 12-h shifts.

The purpose of this study was to examine whether decision-making in registered nurses changed from the beginning to the end of a 12-h day shift. The nurses were provided with information about a patient’s vital signs and perceived level of pain. They then rated how likely they were to call a physician based on the information provided. We also examined subjective measures of alertness, stress and sleepiness. We tested two hypotheses:

(i) The nurses’ decision-making policies would change from the beginning to the end of the work shift.
(ii) Changes in decision-making of the nurses would be related to changes in their levels of alertness, stress and sleepiness from the beginning to the end of the work shift.

Methods

Registered nurses working in a large south-eastern USA metropolitan hospital were asked to participate. The nurses worked 12-h shifts, either from 7 a.m. to 7 p.m. or from 7 p.m. to 7 a.m. and had to report to work 30 min prior to the actual start of their shift to participate in the shift-changeover duties. The current study focused on nurses working a 12-h day shift from 7 a.m. to 7 p.m. Participation was open to all nurses working on the 12-h day shift during the data gathering period. The participants received points toward continuing education requirements expected of all nurses at the hospital. The institutional review board for ethical standards at Clemson University approved the study. All nurses signed an informed consent form that detailed the specifics of the study prior to participation.

To test the stability of decision-making across a 12-h shift, we used a policy-capturing technique that asked nurses to make decisions about hypothetical patients. Policy capturing is a regression-based technique that provides a number of scenarios where respondents make a judgment based on the information provided. We used the established approach of working with subject matter experts (SMEs) to identify what criteria to implement in the decision scenarios [18]. Our decision scenarios used several ‘cue’ variables, each with two or three levels [19], to provide the nurses with enough but not too much information.

To develop plausible and relevant scenarios, we asked four nursing professionals to serve as SMEs. They had extensive practical and academic experience in nursing, including in staff nursing and as family nurse practitioners, nursing professors, principle and co-principle investigators on nursing research projects, nursing journal reviewers and reviewers of professional licensing and certification exams. With the SMEs, we developed scenarios about a hypothetical 60-year-old man who had recently undergone a colon resection. The decision in each scenario was ‘How likely are you to call a physician?’ based on changes in the patient’s status on a 1 (not at all likely) to 7 (absolutely likely) scale. The SMEs determined that this type of scenario, although more common in some nursing units than others, represented a common decision-making process for nurses and that all trained nurses would have the necessary background to complete the scenarios.

Each scenario consisted of three constant and three cue variables based on the recommendations from the SMEs (see Table 1). The constants were temperature, respiration and the patient’s quality of pain. The three cue variables were a combined blood pressure and heart-rate cue (BP/HR; based on the SMEs suggestion that these two variables be linked), oxygen saturation (O2) and pain severity (pain). A sample scenario is provided in Table 2. The combination of cues and the levels of the

| Table 1. Constant and cue variables used in the policy-capturing scenarios |
|-----------------------------|-------------------|
| Variables                  | Values            |
| Constant variables         |                   |
| Temperature                | 97.2°F            |
| Respiration                | 14                |
| Pain description           | Intermittent and acute |
| Cues variables             |                   |
| BP and HR                  |                   |
| 120/72 BP changes to 110/64; |                   |
| 95 HR changes to 100        |                   |
| 120/70 BP changes to 100/54; |                   |
| 92 HR changes to 101        |                   |
| 120/72 BP changes to 90/46; |                   |
| 94 HR changes to 110        |                   |
| 120/72 BP changes to 130/88; |                   |
| 95 HR changes to 91         |                   |
| 120/70 BP changes to 140/88; |                   |
| 92 HR changes to 85         |                   |
| O2 saturation               | 88%               |
| 93%                         |                   |
| Pain severity ratinga       | 3                 |
| 7                           |                   |

*aPain severity rating used a numerical pain scale from 0 (no pain) to 10 (worst possible pain).*
cues produced 20 unique scenarios. After development, the scenarios were tested in a pilot study, which indicated that the 20 scenarios would provide stable but challenging judgment situations.

The scenario questionnaires were administered to the participants at the beginning and at the end of the shift. The participants also completed a pre-shift and post-shift questionnaire asking about subjective measures of current alertness, stress and sleepiness. The measures of alertness, stress and sleepiness were assessed using visual analogue scales (VAS), consisting of a 100-mm horizontal line with the appropriate end points (e.g. extremely sleepy to not at all sleepy). The participants were instructed to draw a vertical line intersecting the horizontal line indicating their current level of the relevant state. The VAS provides a reliable measure to assess these constructs in a repeated-measures design under fatigue-inducing conditions [20].

Data gathering took place on weekdays and Saturdays over a 3-week period. The assistant nurse manager attended the pre-shift meeting on each floor the day before data collection to discuss the opportunity to participate in the research project the following work day. The nurses were told that participation was voluntary and that the 20 scenarios would provide stable but challenging judgment situations.

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To analyze the decision-making data, the judgments for the 20 pre-shift scenarios within participant were regressed on the cue variables (BP/HR, O₂ saturation, pain severity) to yield regression weights (‘cue weights’). The three cue weights form a vector that is a quantitative index of each participant’s judgment policy [19]. This procedure was then repeated for the post-shift scenarios. The post-shift vector was subtracted from the pre-shift vector for each nurse. The magnitude of this difference (i.e. the square root of the sum of the squared values) was calculated. This magnitude is the judgment policy change (JPC) across the work shift. As such, a perfectly consistent judgment policy across the shift would have a JPC score of zero. We then used single-sample t-tests with a test value of zero to examine whether there was a significant change in the JPC values across the work shift and to examine the absolute values of the pre-to-post shift differences in the cue weights to determine if the observed JPC was the result of changes in all three cues.

To analyze the VAS data, we completed dependent t-tests to determine if there were changes in alertness, stress and sleepiness across the 12-h day shift. Finally, we examined the correlations between JPC and reported changes in alertness, stress and sleepiness. All data analyses were completed in SPSS 19.0 (IBM, Armonk, NY, USA).

### Results

A total of 158 nurses were invited to take part. Seventy-eight responded; 13 did not complete all surveys and were dropped from the study, leaving 65 final participants, a response rate of 41%. The majority of participants were female (89%) with an average age of 35 years (SD = 10). They reported working as registered nurses for an average of 7.7 years. The average time at work was 12.4 h during the day of the study. The nurses worked in a variety of areas in the hospital, with the majority working in critical care/cardiac (31%), medical/surgical (27%) and the emergency room (23%).

The mean JPC from pre-shift to post-shift (0.4) was significantly different from zero (Table 3; Figure 1). The nurses showed significant changes across the shift in their willingness to call a physician given a particular patient’s information or cues. Also for all three cue variables, the mean of the absolute value of the pre-shift to post-shift cue changes was significantly different from zero. Since a significant change in judgment policy was observed,
we analyzed the raw differences in the individual cues to check for directionality. No significant difference was found in the actual direction of the change.

Analyses of the cue weights indicate that the participants did not use all three cue variables to make their decision on the pre-shift decision-making questionnaire. The mean standardized regression weights for the pain ratings and O2 saturations were significantly different from zero (mean = 0.180, t(64) = 6.44, P < 0.001; mean = −0.444, t(64) = −12.2, P < 0.001 for pain and O2, respectively). The mean regression weight for BP (mean = −0.2) was not significant. Moreover, exactly this pattern of results was observed for the post-shift responses. The mean standardized regression weights for pain and O2 were significantly different from zero (mean = 0.147, t(64) = 3.80, P < 0.001; mean = −0.411, t(64) = −9.08, P < 0.001, respectively), while the mean regression weight for BP was not significant (mean = −0.016).

One possible cause for the observed policy change might have been how the nurses responded to the policy-capturing questionnaire. For example, the apparent policy change could have been the result of the nurses being systematically more consistent in their responses at the beginning versus the end of the shift. To check for this possibility, we completed an additional t-test of the R² values from pre-to-post shift (Table 3). We found no significant difference in the R² scores from the beginning to the end of the shift (beginning of shift R² = 0.40, end of shift R² = 0.44), indicating that there was little or no systematic change in the consistency of responses provided by each individual nurse on the policy-capturing task.

The VAS data indicated that there was a significant decrease in the participants’ average alertness from pre-shift to post-shift (mean = −14.1, t(54) = 3.47, P < 0.05). There was also a significant increase in the participants’ reported stress across the shift (mean = 24.9, t(53) = −5.04, P < 0.001). While the participants reported an increase in sleepiness from the beginning to the end of the shift (from 36.5 to 41.1), this difference was not significant. Likewise, the trend for the correlation between JPC and stress was not significant.

**Discussion**

Our study found that nurses significantly altered their judgment policies across a 12-h day shift, supporting our first hypothesis. We also found that the alterations in judgment policy were not in a single direction or based on a single cue, suggesting that the participants did not simply use less information or favor one type of cue over another (e.g. pain severity over oxygen saturation) at the end of the shift. The VAS results did not support our second hypothesis that this was as a result of altered alertness, stress or sleepiness.

![Figure 1](image-url)
Research examining clinical decision-making in nursing has focused on better understanding the types of decisions nurses make [21]. This study extends previous research by implementing policy-capturing methodology that focused on changes in nurses’ decision-making. Our results indicate that the nurses did not maintain consistency in their judgments and that the changes in their judgment policies differed between individuals. One potential implication of this finding is that the effects of fatigue and stress on judgment in a 12-h day shift may manifest themselves in ways that vary among individuals. For example, some nurses may place more weight on a patient’s reported pain, while some may place more weight on objective measures such as oxygen saturation. Future research could be designed to address potential moderating variables in decision-making in nurses.

The Controlled Attention Model provides a means to understand why the effects of stress and fatigue could differ across individuals. The model [22] proposes that the ability to focus attention on the task at hand may be a primary determinant of performance efficiency, even in complex decision-making tasks. Under shift work conditions, the model suggests that less alert or sleepy workers would have difficulty maintaining the necessary attention to complete tasks that are not intrinsically interesting [23]. There is growing evidence that the Controlled Attention Model is useful in understanding a wide range of detrimental processes due to fatigue and sleep deprivation [24–29]. In this study, it is possible that reviewing the health status for patients became less engaging from the beginning to the end of a shift, resulting in a need for more controlled attention to achieve more consistent decision-making.

It is interesting to note that there was no significant change in subjective sleepiness from the beginning to the end of the 12-h day shift in this study. One explanation is the influence of the endogenous circadian rhythm, making people feel less sleepy in the early evening hours (6 to 8 p.m.), exactly when the nurses in our study were completing their post-shift surveys.

Our study has several limitations. The written scenarios developed for the policy-capturing task could have lacked realism to the nurses since they were not actual patient situations [19]. Although it is impossible to account in full for this limitation, the scenarios were developed in response to considerable input from the SMEs and were tested in a pilot study for reliability. Another limitation was that specific cues had to be chosen for the scenarios. Using more levels for any of the cue variables would have resulted in an unwieldy number of possible scenarios. Future studies could address this issue by including more levels or selecting alternative levels for the cue variables. A final limitation is that the nurses read the same set of scenarios at the beginning and end of their 12-h shift. It seems likely that the nurses would not remember specific scenarios after 12 h of working, but this is a potential limitation in the study design.

The results indicate that nurses change their decision-making policies from the beginning to the end of a 12-h day shift. We theorize that a possible mechanism behind these changes in decision-making is the ability to maintain focus as suggested by the Controlled Attention Model. Previous research suggests that working day shifts can result in increased work-related accidents [30]. More specifically in nurses, clinical decision-making has been shown to be compromised under shift-work conditions [21]. Due to the greater demands placed on nurses in recent years, it is increasingly important to document how these demands may impact the quality of nursing care. Shift work in health care is unavoidable, so it is important for researchers and clinicians to work together to develop methods that allow us to reliably measure and better understand the effects of shift work and to develop potential countermeasures to help ensure consistent high-quality patient care.

Key points

- Clinical judgment in registered nurses in this study changed from the beginning to the end of a 12-h day shift.
- The Controlled Attention Model suggests that the observed changes in judgment could have been due to decreased attention to the task.
- The current results expand on previous research indicating that shift work negatively affects performance and suggest that complex decision-making processes are also negatively affected.

Conflicts of interest

None declared.

References