International Journal of Nursing Studies 51 (2014) 1230–1240

Contents lists available at ScienceDirect

International Journal of Nursing Studies

journal homepage: www.elsevier.com/ijns

An investigation of differing levels of experience and indices of task management in relation to scrub nurses' performance in the operating theatre: Analysis of video-taped caesarean section surgeries

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ARTICLE INFO

Article history:
Received 8 March 2013
Received in revised form 8 January 2014
Accepted 10 January 2014

Keywords:
Scrub nurse
Operating theatre
Expertise
Task management
Interruption
Observation study

ABSTRACT

Background: Literature has identified failures in task management as direct determinants leading to accidents in the operating theatre. However, very few studies have investigated the factors underlying task management that directly influence the performance of the scrub nurses. The traditional belief that expertise is a general indicator of performance has been empirically investigated with varying results, but none has attempted to identify the task management determinants affecting performance, as influenced by the level of expertise.
Objectives: (1) To examine any difference on task management behaviours between differing levels of experience during surgeries. (2) To correlate indices of task management with levels of performance evaluated by subject matter experts.
Design and setting: 10 experienced and 10 novice scrub nurses were randomly selected from the Obstetrics and Gynaecology Department of a teaching hospital in Singapore. All nurses partook in a caesarean section surgery each, and their work processes were recorded via a scene camera donned by themselves.
Participants: 20 scrub nurses.
Methods: Two human factors experts independently mapped the task management processes onto a task management timeline, where individual tasks were coded, tallied and compared between levels of expertise.
Main outcome measures: Reactive task management (task interruptions, task prioritizations), pro-active task management (anticipation, failures in anticipation), SPLINT scores (performance).
Results: Novice nurses showed lower resistance to interruptions during their tasks (58% more interruptions), especially to interruptions which were not triggered by the surgeon during their surgical counts (90% more interruptions). The novice nurses also displayed poorer/less ability to anticipate the surgeons' needs, taking longer time to handover instruments (39% longer) and making more mistakes (371% more errors). Subject matter experts rated the experienced nurses significantly higher in their cognitive non-technical skills performance than the novice nurses (32% higher).

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0020-7489/$ – see front matter
http://dx.doi.org/10.1016/j.ijnurstu.2014.01.005

Conclusions: Experienced nurses performed better than novice nurses in all aspects of task management indices and expert evaluation. This suggested better task management as effected by expertise, displaying better prioritization, planning and awareness. With these findings, it would be easy and useful to draw causal effects that can in turn guide the design of training, leading to a desirable increase in levels of efficiency and patient safety in the operating theatre.

What is already known about the topic?

- Failures in task management are direct determinants leading to accidents in the operating theatre.
- Expertise is a general indicator of performance.
- No formal study investigated the task management indices directly influencing the performance of a member of the surgical team, as a result of experience.

What this paper adds

- Experience leads to better task management indices and non-technical skills performance ratings.
- Experienced nurses are more resistant to interruptions, adhering to a hierarchy of task importance, especially during safety critical tasks like counting.
- Experienced nurses have a better mental model of the progression of the surgery, allowing for accurate and timely anticipation of surgeons' needs.
- Better task management indices are correlated with higher performance.

1. Background

Accidents in high risk industries such as aviation and nuclear power plant, are often the result of poor task management (Chou et al., 1996; Dismukes et al., 2001; Dismukes, 2010; Funk, 1991; Loukopoulos et al., 2009). In the healthcare domain, an analysis of 10 articles that included quantitative data collected exclusively from the intensive care unit found that there were 5610 contributory factors in 2677 critical incidents. Of these factors, 50% could be attributed to some form of non-technical skill deficit, the largest proportion of which falls under the category of task management (Reader et al., 2006). This is also true for patient safety in the operating theatre; the scrub nurses switch their attention from the task of counting sponges and sutures to deal with an interruption (e.g. a request from the surgeon) and then fail to bring their attention back to the safety-critical task of counting (keeping track).

When scrub nurses are under excessive workload or expect to face high workload in the near future, they adopt different strategies of task management. Hart and Wickens (1990) found that people tend to be more proactive in task management, planning ahead and doing tasks before their deadline when workload is modest; and are more reactive when the workload becomes high, delaying tasks until just before their deadline. In a complex task environment like the operating theatre, scrub nurses can find themselves dealing with many parallel tasks at hand. For example, in addition to the primary tasks of aiding the surgeon and performing surgical counts, scrub nurses need to monitor the status of the patient, keep track of the surgery, prioritize subtasks and anticipate future tasks. They are required to manage available resources in order to complete tasks on time and to an adequate performance level (Koh et al., 2009). Reactive task management which is closely related to interruption management because most interruptions cannot be anticipated (Trafton and Monk, 2007; Wickens et al., 2013) and pro-active task management, which involves particularly, task anticipation, are therefore important strategies adopted by healthcare practitioners to plan ahead of time or to deal with periods of excessive mental workload.

Studies in interruption management often occur in an overload situation when a person cannot perform both tasks concurrently, and hence typically "reacts" to the interrupting task by pre-empting the ongoing task, or delaying (and sometimes ignoring altogether) the interrupting task. Anticipation, by contrast, more often occurs in lower workload periods when the human operator, here a nurse, anticipates a task, and either does it, or prepares to do it well ahead of time. Thus reactive task management and anticipation are not polar opposites. Rather they represent different kinds of behaviour, each of which can vary in their degree of optimality. In particular, the distinction between reactive (less optimal) and proactive (more optimal) task management is a critical one for the current analysis, even as reactive task management itself can vary in its degree of optimality (e.g. preventing a less important interrupting task from disrupting a more important ongoing task). In Section 1.1, we defined these two terms explicitly.

The present study thus describes the task management analysis from a study reported in Koh et al. (2011). Koh et al. (2011) examined expertise in task management from the perspective of optimal modelling of visual scanning, whereby a predictive component of the scan model employed was the relevance of particular scan areas to highest priority tasks. They observed that experienced scrub nurses adhered more closely to this optimal priority-driven scan pattern than novices. The eye tracking setup from the study also provided observational (video) data from a scene camera, which is the target of the current paper. The analysis underlying the present study focuses on management of tasks, rather than direction of visual attention. A task analysis described in Koh et al. (2011) identified that one of the most critical tasks performed by the nurse was the closure count; required to keep track of every item (sponges, instruments, etc.) introduced into the sterile field and possibly placed in the surgical cavity. The potential consequences of a failure in this task, leading to a