Simulating high workload situations to evaluate patient monitors

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Introduction

Anesthesia simulators are being used to evaluate how effectively different displays convey physiological information to the anesthesiologist [1, 2].

Anesthesiologists' vigilance levels are often higher in simulators than in the operating room because anesthesiologists expect adverse events to occur in the simulator. The increased levels of vigilance could mean that results from simulator trials may not represent anesthesiologists' performance in the operating room.

Because vigilance-based errors occur more frequently at low arousal levels and under high task load when people are limited by their cognitive resources [3], anesthesiologists' workload may be manipulated in simulators to overcome the heightened levels of vigilance.

Distractor task workstation

Participant performing distractor task while junior colleague takes care of patient

Methods

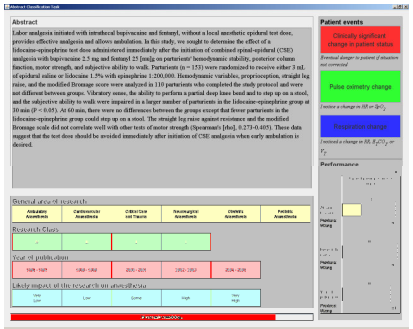
We have developed a task that produces a controlled level of distraction for anesthesiologists while they participate in simulated scenarios.

The abstract classification task (ACT) requires the anesthesiologist to read a series of anesthesia abstracts and to classify each abstract according to:

a) general area of research,
b) research evidence class,
c) year of publication, and
d) likely impact of the research on anesthesia.

Performance feedback was provided on the first three classifications. To motivate participants to focus on the task, performance feedback can also indicate the best performance achieved during development and piloting of the task, in the study to date, or as a target level only.

The ACT was first used as described above for a study of advanced auditory and head-mounted displays reported in Sanderson et al [4].



Interface of abstract classification distractor task

Results

Without requiring hundreds of hours of simulator time, the ACT successfully simulated occasions on which anaesthesiologists become distracted in the operating room.

As intended, anesthesiologists showed approximately equivalent levels of distraction across display conditions.

The number of abstracts completed during each 22-minute anesthesia scenario did not change across displays.

For questions a) and c), average performance was better than chance (16.6% and 20% respectively) but did not change across displays.

For question b) about research evidence class, performance was again better than chance (37%). Performance improved slightly as displays reduced the degree of continuous awareness participants had of the patient's state, so was best in the Visual condition where participants did not use any advanced displays.

Responses to question d) were not scored, as they simply involve forming an opinion.

Some anesthesiologists were distracted for periods more than two minutes even though they expected adverse patient events in the scenarios.

Distractor task results in Sanderson et al [4]

	Visual	Visual + HMD	Visual + Auditory	Visual + Auditory + HMD
Number of abstracts completed	38.5	37.7	37.8	37.6
a) Correct anesthesia category classifications	69%	66%	67%	68%
b) Correct research evidence class classifications	**58%**	55%	52%	50%
c) Correct year of publication	36%	36%	34%	34%

Visual = standard monitoring + variable-tone pulse oximetry. HMD = head-mounted display
Auditory = respiratory sonification (RR, ETCO2, Vt) and NIBP auditory "earcons"
Bold = significantly different from Visual + Auditory + HMD at p=0.05 in Tukey HSD test

Discussion

The ACT distractor task made it easier to identify significant differences in anesthesiologists' ability to detect simulated patient events across a range of patient monitoring displays [4] with only 16 participants. Many variants of the ACT are possible, depending upon investigative needs.

Although artificial in nature, such distractor tasks may have the potential to produce patient monitoring patterns closer to those observed in operating theatres where hypervigilance is less than in simulators and where many work-related distractors are present.

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Acknowledgments

This research is supported by Australian Research Council Discovery Project grant ARC DP0559504 to P. Sanderson, M. Watson, and W. J. Russell.

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