

Head-mounted display evaluation in anesthesia for rigid cystoscopy

D. Liu ^{BEng(Hons), *}, S. Jenkins ^{MBBS FANZCA **}, P.M. Sanderson ^{PhD FASSA *},
Perry Fabian ^{MBBS **}, W.J. Russell ^{MBBS DIC FANZCA FRCA}

* Cognitive Engineering Research Group, The University of Queensland
** Department of Anaesthesia and Intensive Care, Royal Adelaide Hospital

Aims. We evaluated a head-mounted display (HMD) of vital signs in the clinical environment to determine whether the effects of HMDs found in prior simulator studies would (a) generalize to practice, and (b) be any different during crisis management (should a crisis occur).

Background. Head-mounted displays (HMDs) can superimpose the patient's vital signs over the anesthesiologist's field of view. Prior simulator studies indicate that anesthesiologists using an HMD spent more time looking towards the patient and less towards the monitors [1,2], and detected vital signs changes faster than otherwise if they were busy and physically constrained [3,4] except they also detected a waveform change more slowly [3]. During routine monitoring however, anesthesiologists did not detect events faster with an HMD [1,5].

Methods. Six attending anesthesiologists (Royal Adelaide Hospital) each provided anesthesia to six patients undergoing rigid cystoscopy; alternating between standard monitoring, and standard monitoring plus the HMD. The HMD displayed waveforms and numerics measured by a Philips IntelliVue™ MP70 and an MP30 monitor. Tidal volumes were measured on a Datex-Ohmeda Aestiva®/5 ventilator but were not available on the HMD. Video data were analyzed to determine the proportion of time, frequency, and duration of the anesthesiologist's looks at the anesthesia machine and at the patient during normal anesthetic phases and crisis events. Differences during normal anesthesia were tested for significance using repeated-measures ANOVAs with $\alpha=0.05$, and differences during crisis events were compared with *t*-tests of independent samples and Mann-Whitney U tests with $\alpha=0.05$.

Results. With the HMD, participants spent less time looking towards the anesthesia machine (21.0% vs 25.3%, $p=0.003$) and more time looking towards the patient (55.9% vs 51.5%, $p=0.014$) compared to standard monitoring. While managing a regurgitation episode, an anesthesiologist using the HMD spent less time looking at the anesthesia machine (9.9% vs 26.1%, $p=0.035$), looked towards the anesthesia machine less frequently (1.36 vs 3.61 looks per minute, $p=0.009$), and looked at the patient for longer each time (16.212 vs 2.773 seconds, $p<0.001$) compared to their standard monitoring baseline.

Conclusions. An HMD with patient vital signs improves anesthesiologists' monitoring of their patient's clinical signs during normal anesthesia and especially during crisis management.

References:

- [1] Liu D, Jenkins S, Sanderson PM, Leane T, Watson MO, Russell WJ. Simulator evaluation of head-mounted displays for patient monitoring. *Anesth Analg* 2008;106(S2):S-34.
- [2] Ormerod DF, Ross B, Naluai-Cecchini A. Use of an augmented display of patient monitoring data to enhance anesthesiologists' response to abnormal clinical events. *Stud Health Technol Inform* 2003;94:248-250.
- [3] Liu D, Jenkins S, Kruys A, Sanderson PM. Part-task trainer evaluation of a head-mounted display for physically constrained anesthesiologists. *STA Annual Meeting* 2009.
- [4] Via DK, Kyle RR, Kaye, RD, et al. A head mounted display of anesthesia monitoring data improves time to recognition of crisis events in simulated crisis scenarios. *STA Annual Meeting* 2003.
- [5] Sanderson PM, Watson MO, Russell WJ, et al. Advanced auditory displays and head mounted displays: Advantages and disadvantages for monitoring by the distracted anesthesiologist. *Anesth Analg* 2008;106(6):1787-1797.