EVALUATION OF AN EXPERT SYSTEM FOR DETECTING VENTILATORY EVENTS DURING ANESTHESIA IN A HUMAN PATIENT SIMULATOR

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Background: Current perioperative monitoring systems produce a huge amount of largely un-interpreted data, employ threshold alarms prone to artifacts and rely on the clinician to continuously visually track changes in multiple sources of physiological data over time. A prototype expert system "eVent" was developed to make full use of this data and provide real-time clinical decision support. It uses a validated set of limits and rules for the identification of selected critical events during anesthesia [1]. The purpose of this study was to evaluate the efficacy of the expert system in enhancing the anesthesiologist's ability to detect critical events in a simulated operating room environment.

Figure 1: Anesthetic setup for the anaphylaxis scenario. The decision support system (black monitor) is seen at

Methods: A high fidelity human patient simulator was used to simulate an operating room. Study participants were randomized to experience four scenarios: Anesthetic vapor overdose, tension pneumothorax, anaphylaxis, and endotracheal tube cuff leak. The expert system was placed on top of the usual anesthesia displays and in half of the scenarios the expert system provided trend-based alerts and differential diagnoses. Time to diagnosis (detection) and time to treatment (clinical intervention) were measured. Workload questionnaires [2] and structured debriefings were administered after each scenario. A usability questionnaire [3] was completed at the conclusion of the simulation session.

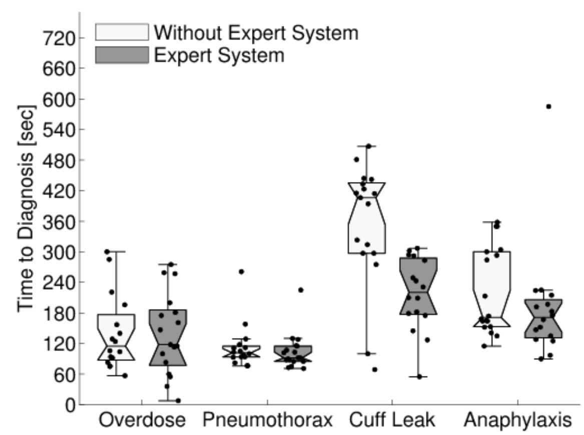

Figure 2: Time to Diagnosis, Grouped by Scenario. Each icon shows the lowest value, the lower quartile, the median value, the upper quartile, and the uppermost value. A dot denotes each datum.

Results: Fifteen anesthesiology residents, 5 anesthesiology fellow physicians, and 15 staff anesthesiologists participated in this study; 24 were male. The median age (range) was 36 (29-66) years with a median (range) of 6 (1-38) years of anesthesia experience. A significant improvement in both time to detection and time to treatment was observed in the ETT cuff leak scenario; a median reduction by 185.5 and 128.5 seconds respectively. No reduction in times to detection and treatment were found for any of the other three scenarios. Participants were highly satisfied (median of 2 on a scale of 1-7) with the expert system. Three areas critical to safety: Avoidance of task fixation, reassurance to initiate invasive treatment, and confirmation of a suspected diagnosis, were identified from the debriefings.

Conclusions: Participants appreciated the system's support in making their diagnosis and encouragement to perform invasive treatments. Many participants noted that the system prevented them from falling victim to task fixation and expressed their desire to have access to such a system during their routine clinical activities. We had hoped to show an improvement in all scenarios but only found an improvement in one scenario. Nevertheless, we were encouraged by the skill and performance of the study participants both with and without the expert system. The study highlights the difficulty in simulating the clinical environment in a situation when participants are aware that something is very likely to happen within a short space of time.

References

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3. International Journal of Human-Computer Interaction 1995; 7(1):57-78