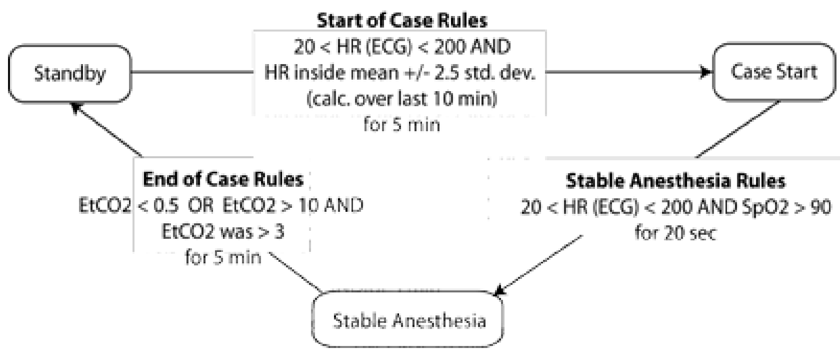
AUTOMATED PHASE OF ANESTHESIA DETECTION FOR PROVIDING CONTEXT APPROPRIATE ALERTS

Dustin Dunsmuir; Jonathan Stinson; Dorothy Myers; Mark Ansermino
Department of Anesthesiology, British Columbia Children's Hospital, Vancouver, British Columbia, Canada

Introduction: The increasing number of parameters being monitored in the operating room has consequently increased the number of alarms. With the introduction of intelligent clinical decision support systems such as *iAssist* [1], false alarms are even more likely. The knowledge rules within *iAssist* were designed for use in the stable phase of anesthesia, but the system lacked this context and fired rules throughout a case. In addition, clinicians have multiple tasks to perform at the start and end of a clinical case and do not have time to initiate the system between cases. To facilitate the automated detection of the phases of anesthesia we have developed a set of phase rules, which deactivate or activate the knowledge rules as appropriate.

Method: The rules for triggering the onset of each of three anesthesia phases: Start of Case, Stable Anesthesia, and End of Case, were selected by referencing real cases and expert clinician opinion. The expert system is initialized with the selected knowledge rule set and the details of the first case. The system runs in standby mode until the start of case is detected, when graphs and trends are displayed and data recording is initiated. Upon detection of stable anesthesia, a popup window requests confirmation to initialize the expert system.



Confirmation is required from the clinician when the end of case is detected for the system to enter standby mode. For each subsequent start of case the clinician is prompted to enter new case details. A 5 minute delay in further detection is introduced if the clinician cancels a phase change. Phases can be changed manually. The tuning of the phase rules have been iteratively improved. Twenty case recordings were examined with and without phase detection to determine the number of unnecessary alerts avoided. All cases were of at least an hour duration and half of the cases ran with phase detection in real time and half were run with phase detection offline.

Results: Phase detection eliminated a median (SD) of 6 (5.56) alerts per case during the induction of anesthesia. The difference in the number of outcomes was significant (Wilcoxon matched-pairs signed-rank test $p < 0.001$). Of the 10 cases originally run without phase detection, 3 included clinician comments marking outcomes as occurring out of context during induction of anesthesia. An additional benefit of the detection of Start of Case and End of Case is that record fusion is avoided (fusion of cases had occurred in 3 of the 10 pre-phase cases).

Discussion: The use of automatic phase detection has provided the intelligent monitoring system an awareness of the context in which support is provided. Phase detection has the potential to improve clinician performance by preventing unnecessary false alerts that degrade the response to clinical alerts. Future research will be directed towards demonstrating an improved response to true adverse events.