ADAPTIVE CHANGE POINT DETECTION ALGORITHM FOR HEART RATE IN CHILDREN

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INTRODUCTION: The astute pediatric anesthesiologist uses subtle changes in patient heart rates to monitor changes in anesthesia depth and dictate fluid administration. Clinicians can perceive fluctuations of three to four beats per minute from auditory signals¹; but may become distracted by simultaneous tasks. We have attempted to replicate optimum clinician performance in an automated system.

METHODS: Following institutional ethical approval, trend heart rate data was collected from 53 children. Clinically detected changes in heart rate, using standard auditory and visual monitoring, were recorded in synchrony with the trend data. A purpose-built graphical interface was used for post-hoc expert marking of episodes of heart rate increase; graded as definitely or likely significant/ insignificant or artifact using predefined criteria. Following data segmentation, an automated change-point detection algorithm, with adaptive Kalman filtering and a local CUSUM, was used to identify points of increasing heart rate. The relative performance of the algorithm and real-time clinicians was compared against the post-hoc expert review.

RESULTS: Five cases were excluded due to incomplete data. Results from the remaining sample indicated that the automated trend detection algorithm performed as well as clinicians under test conditions, without a significant increase in the false positive detection rate.

Monitoring Performance	Post Hoc Expert	Automated Algorithm	Real Time Clinician
True HR increase	109	79	80
Missed HR increase	0	30	29
False HR increase	0	27	33

DISCUSSION: The exponential increase in monitored physiological parameters within the operating room has raised the cognitive burden of anesthesiologists faced with interpreting the resultant streams of data. By improving time series analysis, computational pattern recognition, knowledge representation, automated reasoning and intelligent communication, human performance can be enhanced.

The automated method seems to describe the signal efficiently; however, it is unlikely to be applicable to all physiological signals without significant tuning. Further work is needed on the classification and organization of change points and the simultaneous integration of multiple signals.

REFERENCES: 1. *Anesth Ana* 2004; 98:A76.