INTRODUCTION: Near-infrared spectroscopic (NIRS) cerebral oxymetry based on low density sensor array is often used to monitor brain perfusion during surgery. However, it is uncertain whether sampling small areas over the frontal lobe adequately characterizes the underlying dynamic response of cerebral perfusion in patients undergoing cardiac surgery.

METHODS: A NIRS imager with high density sensor array (211 source-detectors [channels]) was used to simulate multiple oxymetry devices, which typically consist of only 4 channels. Continuous recording of relative oxygen saturation were obtained from each channel. Data were collected from 4 distinct sites in the frontal region from 6 patients during cardiac surgery. Control time periods of hemodynamic stability and acute hypotension intervals, where mean arterial pressure (MAP) dropped at least 25mmHg were analyzed.

RESULTS: Binomial analysis showed that channels greater than 2cm apart (sampling deeper tissue) had higher median correlation values than channels less than 2cm during event periods ($p=0.0182$). Kruskal-Wallis tests yield significant differences in channel-MAP correlations between 4 sites in the frontal region for control and event time periods ($p<0.02$ 22/24 controls, $p<0.02$ 12/13 events). Sensitivity analysis based on individual channel amplitude showed it is necessary to lower the alert threshold by 90%, relative to the largest observed oxygen saturation change, in order for 50% of the channels to report the event.

CONCLUSION(S): This study showed high spatial variance in the hemoglobin signal during cardiac surgery. This variability degrades the reliability of metrics intended to detect clinically significant events. Low density oxymetrydevices are unlikely to provide reliable representation of cerebral perfusion.