Comparing Trends in Blood Pressure Computed from the Arterial Line and Sphygmomanometer in the ICU

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It has been previously shown that there is an underlying bias in blood pressure (BP) measurements between the arterial line and the sphygmomanometer cuffs. It is unclear the extent to which this bias can lead to differences in the standard of care inside the Intensive Care Unit (ICU) where physicians are often interested in identifying patterns of the patient’s physiology, usually across 24 hours. The objective of this study was to compare the circadian patterns in BP derived from simultaneous measures of arterial lines and sphygmomanometer cuffs in the ICU.

We selected a cohort of patients that had coinciding arterial line waveforms and sphygmomanometer cuff measurements from the MIMIC-III database. The arterial line waveforms were preprocessed to determine estimates of systolic, diastolic, mean arterial BP (SBP, DBP, MAP) and an estimate of signal quality at times of cuff inflations.

3,500 patients made up the cohort, resulting in 26,338 data-points of paired BP from the arterial line and sphygmomanometer cuff. A significant bias between the two measurement sources was found for SBP and MAP but not for DBP. In addition, a significant proportion (SBP - 51%, DBP - 23%, MAP - 41%) of cuff measurements had an error greater than 10 mmHg from the arterial line, a threshold set by the governing bodies (AAMI, ESH, ISO) for a non-invasive BP device. Despite these errors, the circadian rhythms between the two signals showed a high correlation: SBP - $r = 0.95 \ p < 0.001$; DBP - $r = 0.89 \ p < 0.001$; MAP - $r = 0.86 \ p < 0.001$. This work outlines that despite significant errors and bias between the arterial line and cuff, the sphygmomanometer cuff is sufficient to accurately track trends in BP inside the ICU.