**The Impact of Motion and Low Perfusion on the Performance of Masimo SET Pulse Oximeter (PO) and Four other POs for Measurement of Oxygen Saturation (SpO2) and Pulse Rate (PR) in Human Volunteers.**

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## Introduction

Whenever clinically, we doubt the SpO2 value, we look for the waveform and PR displayed by PO, whether the waveform is normal or not and whether the PR correlates with the EKG HR or not. Thus PR measured by PO plays a significant role in the clinician's trust of the SpO2 value given by PO. Many manufacturers have improved their equipment with better technology thus improving the performance of POs during motion and low perfusion. The SpO2 performance of various POs has been compared during various motions [1,2]. However, to our knowledge, PR performance of various POs has not been reported. We undertook this study to assess the impact of motion and low perfusion on the performance of Masimo SET technology and four other improved brands of POs on SpO2 and PR in human volunteers.

## Methods

Seven ASA I adults (5-females & 2-males) between 18 & 40 years of age were enrolled after obtaining informed consent. Masimo Radical v3 (Masimo I) was compared with HP Agilent Viridia 24C Rev B, and Novametrix MARS Model 2001 vTBD. Masimo Radical v3 (Masimo II) was compared with Nellcor N-395 v1620, and HP CMS Rev B. An Ohmeda PO ear sensor was used as the control for hypoxemia. The room temperature was lowered to 16 to 18 degree C to lower peripheral perfusion of the volunteers. The left hand was the test hand while the right hand served as the control. The sensors were randomly placed on index, middle & ring fingers. The motion (performed by a motor-driven motion table) during normoxia (breathing room air) consisted of tapping at 3 Hz, tapping at 3 Hz with disconnect and reconnect of the sensors during motion, and random rubbing. The sensors were than rotated in a lateral fashion allowing for sensor placement of each PO on each of the three fingers and the motions were repeated after each sensor change. The study was repeated with two other POs along with Masimo which was used in both sets of experiments. Hypoxemia was induced employing a disposable re-breathing circuit with a CO2 absorber to a SpO2 of 76 +/- 0.48 SD. The motion during hypoxemia consisted of random tapping and 3 Hz tapping with disconnect and reconnect of the sensors during motion, random rubbing, and 3 Hz rubbing. Once the SpO2 reached 75% as measured by ear sensor, the subjects were given 100% O2 to breathe until his/her SpO2 on the control monitor reached 100%. PR & SpO2 data were recorded on-line for off-line analysis. % of the time when PR was off by 10% (Off 10) or more and SpO2 was off by 7% or more (Off 7), performance index (PI) - % of time when SpO2 was within 7% of control and PR was within 10% of control, and % of time when the POs zeroed out PR and/or SpO2 (Zero rate). Analysis of Variance was used for statistical analysis & $P < .05$ was considered statistically significant.

## Results

The table shows our results. * ANOVA analysis showed a statistically significant difference between the performance of the POs for both SpO2 and PR.

| | | Pulse Rate* | | | Oxygen Saturation* | |
|---|---|---|---|---|---|---|
| Pulse Oximeter | Off10% | PI | Zerorate | Off7% | PI | Zerorate |
| Masimo I | 20% | 80% | 0.5% | 14% | 85% | 0.6% |
| HP Viridia 24C | 53% | 47% | 1.6% | 34% | 65% | 1.6% |
| Novametrix MARS | 72% | 27% | 2.1% | 58% | 41% | 2.2% |
| Masimo II | 21% | 78% | 0.1% | 11% | 89% | 0.2% |
| N-395 | 40% | 50% | 16.7% | 33% | 63% | 6.0% |
| HP CMS Rev B | 32% | 67% | 0.9% | 21% | 78% | 1.6% |

**Conclusion**

While no PO technology amongst the tested POs was able to withstand 100% of the time this vigorous testing schedule for either SpO2 or PR, Masimo SET technology performed better for both SpO2 as well as PR. Furthermore, all POs performed inferiorly for detection of PR in comparison to SpO2 detection.

REFERENCES: 1. Anesthesiology 1997;86:101-108 2. Anesthesiology 2000;93:3A,A549.