**SaO₂ Dependency of Neonatal Pulse Oximetry Accuracy: A Root Mean Square Error Analysis.**
Gerstmann D., Berg R., Haskell R., Brower C., Smith B. *Respir Care* 2003; 48 (11).

**Objective**
To apply a root mean square error analysis to pulse oximeter derived SpO₂ compared to arterial SaO₂ values obtained from neonatal intensive care unit (NICU) patients who require arterial access.

**Methods**
740 paired SpO₂ and SaO₂ values from 42 NICU patients were utilized in the analysis. Data were collected on 3 neonatal pulse oximeters. The root mean square statistic, $\text{Arms} = \left[ \frac{1}{n} \sum \sum (\text{SpO₂} - \text{SaO₂})^2 \right]^{1/2}$, was calculated across patients (i) and samples (j), then separated into 3 components: "within subject" variation (VARWS), "between subject" variation (VARBS), and a "bias squared" (BIASSQ) term. Arms, VARWS, VARBS, and BIASSQ were analyzed in relationship to: a) patient accrual, and b) arterial saturation values.

**Results**
Based on patient accrual, values of Arms, VARWS, and VARBS stabilized by 20-25 patients, whereas the BIASSQ term stabilized somewhat sooner, by 15-20 patients. VARWS seemed consistent between devices, but VARBS was less so. Overall, device Arms was biased by the uneven distribution of samples across SaO₂. All devices demonstrated a similar relationship between Arms and SaO₂, which reached minimum values over a narrow range of SaO₂ (94-97%). Above and below this range Arms increased 2 fold at 99% SaO₂ and 3-6 fold at 82% SaO₂. The largest contributor to the increase in Arms outside the minimum range was BIASSQ, the device measurement error. This component of Arms variation is not accounted for by VARWS or VARBS, and is characterized by the slope of the difference function, [SpO₂-SaO₂] vs SaO₂.

**Conclusion**
The variance of neonatal pulse oximetry readings is dependent on the SaO₂ at which the reading is taken. It is a function of the variability of taking readings on a single patient, taking readings between multiple patients, and the degree of equipment accuracy. The 95% confidence interval for readings at minimum Arms (SaO₂≈95%) is approximately ±4 sat %, and for SpO₂ at 85%, the 95% confidence interval is approximately ±10 sat %.