# Cerebral tissue oximetry in pediatric population: establishing reference values in TD-NIRS measurements.

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## 1. INTRODUCTION:

Precise and reproducible cerebral oximetry measurements can play a pivotal role in functional brain measurements. Although TD-NIRS is becoming increasingly used in clinical research [1], the expected cerebral oximetry values, their variability and normality ranges in diverse human populations still remain elusive. Also, device precision and reproducibility among subjects and repositioning need a careful evaluation.

## 2. METHODS:

350 healthy subjects, aged between 0 and 18 years old, have been enrolled. Data acquisition was conducted by a team of 5 clinicians, using a research-grade commercial TD-NIRS oxymeter (NIRSBOX, PIONIRS s.r.l., Italy) [2] with a compact optical probe having 2.5 cm S/D distance (G5 "Goccia", PIONIRS s.r.l., Italy) and a fully-automated acquisition software with built-in data-quality indicators (Figure 1).
**Measurement protocol:** 5s acquisition duration, 1Hz sampling rate and repeated 5 times over the same location (left pre-frontal cortex, Fp1 of the 10/20 EEG system). Data was processed using a semi-infinite homogeneous model [3]. Percentiles intervals of oximetry values have been estimated using the bootstrapping technique (over 1000 samples).

**350** Subjects **5** Clinical Operators


*Precision of absolute $StO_2$ and tHb cerebral measurements, over repositioning.*

| REPOSITIONING | PRECISION (STD) |
|---|---|
| $StO_2$ | **0.9 %** |
| tHb | **4.2 µM** |

## 3. RESULTS

Measurements were successfully conducted across the entire cohort. The device exhibited consistent stability and reliability across subjects and over time. **No correlation was observed between acquisitions by different operators.** Average tissue saturation ($StO_2$) showed values of 66.9% ± 4.4% (avg ± std) with **measurement precision of was 0.9%** (average std over repositioning). Average total hemoglobin (tHb) was 106.3 µM ± 17.8 µM, with a precision of 4.2 µM.

**Correlation between cerebral $StO_2$ and age of the participant resulted substantia**l, while no significant differences have been found for participant's sex.

**Differential pathlength factor (DPF),** absorption and reduced scattering coefficient values showed no correlation with the BMI z-score (Pearson's R < 0.3). The precision and robustness of the NIRSBOX device resulted higher than state of the art brain oximeters [4]. Preliminary **percentile intervals have been finally drawn** on cerebral $StO_2$ and tHb values in pediatric population, from 0 to 18 years old (Figure 2).

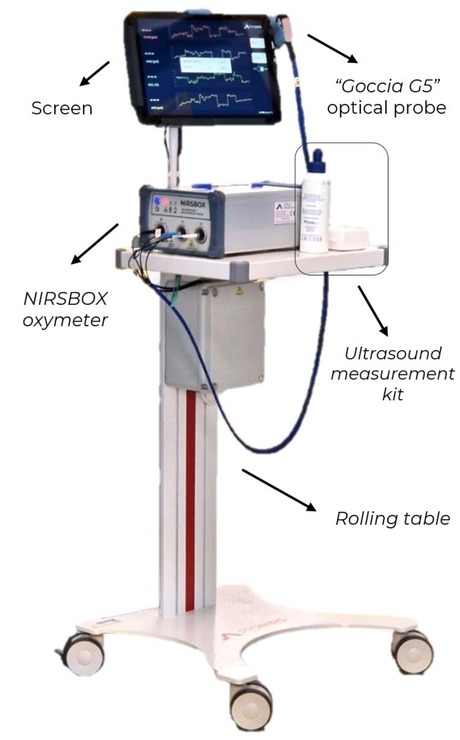


*Figure 1 : NIRSBOX device, as used in the clinical environment (cart-mounted configuration).*

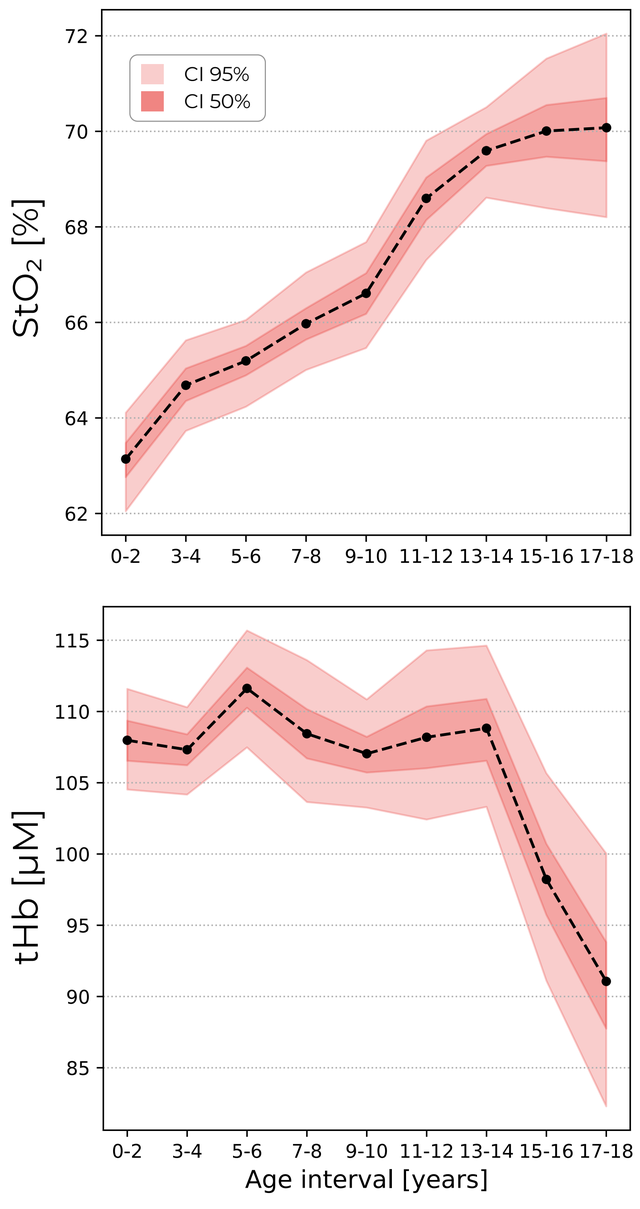


*Figure 2 : Percentiles distribution over age clusters for cerebral $StO_2$ (top) and tHb (bottom) values after bootstrapping.*

## 4. REFERENCES:

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