RESUME_STUDY
Clinical study EOXY
BIOSERENITY_80601-2-61

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Title	Clinical Trial testing the BioSerenity Pulse Oximeter (EOXY) efficacy, performance and safety in healthy volunteer
NCT	NCT03614416
Document date	05 june 2017

Objectives	Primary objective: evaluate the SpO2 and HR accuracy of the Bioserenity pulse oximeter *(EOXY),* evaluating the performance of the device compared to invasive method blood sampling *(SaO2)* by CO-Oximeter, and compared to a pulse oximeter gold standard. Secondary objective 1: measurement of the variation of the fraction of inspired oxygen *(FiO2).* Secondary objective 2: validation of the algorithm for data review and analysis of signal.
Type of the investigational medical device	Type: Wireless non-invasive and reflectance-based pulse oximeter developed by Bioserenity
	Description: As opposed to transmittance oximeters, the photodiodes of reflectance-based oximeters collect the light emitted by the LEDs and reflected *(as opposed to crossing light)* by the bones, tissues and muscles. The reflectance type pulse oximeters can perform measurement from various sites of the body, excluding the limitation of measurement position [1].
	Using of the device for the study: Intended to be used to acquire and transmit recorded data from adults. The EOXY permits non-invasive, continuous acquisition and monitoring of the pulse rate (PR) and of the oxygen saturation level in the blood (SpO2) of adults. For the study, it is intended to be used on different body site as the forehead, the chest or the back.

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Method	According to the European standard ISO 80601-2-61:2011, clinical investigation is conducted in order to assess the performance and safety of pulse oximeters, comparing the measured EOXY SpO2 values to SaO2 values collected by invasive methods using blood sampling, and comparing the EOXY heart rate values to goldstandard heart rate. The EOXY SPO2 and HR measurements, is performed in O2 saturation conditions up to 100% and then in different desaturation plateaus, ranging from 100 % to 70%. Three EOXY pulse oximeters record the SpO2 and HR at the same time in 3 different body areas : chest, back-torso, forehead. Different body areas are tested in order to assess separately the safety and performance of the EOXY device on these areas. The EOXY SpO2 values is simultaneously compared to SaO2 measures providing from invasive blood sampling taken from an indwelling arterial catheter. The EOXY heart rate measures is compared to a gold standard oximeter CE-marked. The controlled desaturation is performed in five progressive plateaus from 100% to 70%. As the example given in the ISO standard, we choose to do the test on the 70-100% desaturation range, with 5 plateaus *(100%-97%; 97%-92%; 92%-85%; 84%-78%; 77%-70%).* 5 SPO2 values, 5 SaO2 values *(blood samples)* and 5 heart rate measures are collected per plateau, for each of 13 subjects. The desaturation plateaus are reached using controlled FiO2 levels performed by a device. It permits to bring subjects near target levels of desaturation plateaus and to maintain them at the target plateau during the 5 blood samples. A number of inclusions of 13 was chosen to have at least 10 subjects, in case of drop-outs or analysis exclusions. ISO 80601-2-61:2011 standard advices to collect 200 pairs of data.
Medical conditions and criteria of inclusion/exclusion	Medical conditions: 13 Healthy subjects Target population defined in accordance Specific population: ☒yes ☐non Description: among the healthy subjects, at least two must have a dark skin pigmentation as required by 80601-2-61:2011 standard and FDA guidance Inclusion criteria: - Healthy subject *(Man/ Women)* > 18 years old - Subject signed informed consent prior to any screening procedure - Subject in good health *(COHb < 3%, MetHb < 2%, CtHb > 10mg/dL).* This criterion is assessed by a finger-prick blood test - Healthy adult capable of undergoing controlled hypoxemia to the level called for in the protocol with minimal medical risk

	Exclusion criteria: - Smokers or individuals exposed to high levels of carbon monoxide that result in elevation of carboxy hemoglobin levels - Individual subject to conditions that result in elevated levels of methemoglobin - Subject who would be placed at undue medical risk associated with any procedure called for in the protocol - Subject with open wounds - Pregnant woman (*negative pregnancy test needed)* - Subject allergic to silicon, polyamide and silver yarn - Subject with cardiorespiratory disorders likely to worsen with thoracic pressure applied by the textile band - Subject with mental or motor impairment preventing him from expressing pain - Subject with blood or skin disorder that may impacting results - Subject with behavioral disorders, too agitated or too aggressive - Subject with sensorial disorders, insensible to skin pain - Subject susceptible to tension/pressure-based headaches No vulnerable subject is enrolled on this study.
Duration of participation and follow-up	Participation duration: 2 days *(3 days for subjects of phase 1)* No follow-up visit planned
End point criteria	Primary objective : -For performance: Collection of 5 different values of SpO2, SaO2 and HR after each desaturation plateau. These values are used for the analysis of the performance of the EOXY device and the performance of the gold standard, following the ISO 80601-2-61:2011 standard. -For safety: Monitoring of vital sign: heart rate (*HR*) continuously, blood pressure and temperature between each desaturation plateau. Also, adverse events are collected during the study. Secondary objective 1 : FiO2 is assessed to bring subjects near target levels of desaturation plateau. No analysis is performed on these data. Secondary objective 2 : Assessment thanks to the signal analysis. No data analysis performed
Statistical method	The clinical performance analysis for this study is assessed by the Accuracy Root-Mean square *(ARMs) (calculated by the difference between the investigational pulse oximeter SpO2 measurement and the co-oximeter's SaO2 measurements*) and is assessed by the Bland-Altman plot visualizing the difference between SpO2 and SaO2.

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	ARMS is a representation of the combination of systematic and random error. It is defined as the accuracy root-mean-square error difference between the measured value and the truth value calculated as below, where "n" is the number of observations, and both SpO2 and SaO2 are defined as: $A_{RMS} = \sqrt{\frac{\sum_{i=0}^{n} (SpO_{2i})^2}{n}}$ According to the ISO 80601-2-61:2011 standard, the accuracy of the SpO2 of the oximeter under test, should have an average root mean square deviation ARMS, equal to or less than 4.0%, over a SaO2 range between 70% and 100%. In the same way, the accuracy of the pulse rate *(HR)* must have an average root mean square deviation equal to or less than 4.0% over the 70-100% range. It is also possible to claim specific accuracies on segments of this range.
Safety assessment	Assessment of the number of undesirable effects
References	[1] Marcus Kramer, Aaron Lobbestael et al. Wearable Pulse Oximetry Measurements on the Torso, Arms, and Legs: A Proof of Concept ; Military medicine 182(S1):92-98 · March 2017