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## APPLICATION OF PULSE OXIMETRY IN NEONATOLOGY

### Abstract

**Introduction and aims:** Commonly performed test neonatal pulse oximetry is used to assess the percentage of oxyhemoglobin and pulse rate. The paper presents an overview of the basics of pulse oximetry. The main aim is to provide a range of uses pulse oximetry in neonatal, especially wu infants born prematurely.

**Material and methods:** The material is data from neonatology literature. The method of analysis and compilation has been used in this paper.

**Results:** Some scheme of operation of the monitor and the effect of light on the wave signal saturation has been developed in the paper. The application of pulse oximetry for the analysis of the state of the newborn has been shortly presented in the article.

**Conclusion:** Pulse oximetry is used to recognize and evaluate symptoms of physiological and pathological newborn. It also allows constant observation of important health parameters newborn and assessing the risk of his life. Mostly treatment in intensive care units can last for many months, so monitoring should be sound, safe and non-invasive to the child and simple and convenient to use.

**Keywords:** Pulse oximetry, background, application, neonatology.

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## ZASTOSOWANIE PULSOKSYMETRII W NEONATOLOGII

### Streszczenie

**Wstęp i cele:** Powszechnie wykonywane badanie pulsoksymetrii noworodków wykorzystywane jest do oceny procentowej zawartości oksyhemoglobiny i częstotliwości pulsu. W pracy przedstawiono ogólny zarys podstaw pulsoksymetrii. Głównym celem pracy jest podanie zakresu zastosowań pulsoksymetrii w neonatologii, szczególnie wu noworodków przedwcześnie urodzonych.

**Materiał i metody:** Materiał stanowią dane z literatury neonatologii. Zastosowano metodę analizy i kompilacji.

**Wyniki:** Opracowano schemat działania pulsoksymetru oraz wpływ światła na sygnał fali saturacji. Omówiono zastosowanie pulsoksymetrii do analizy parametrów stanu noworodka.

**Wniosek:** Pulsoksymetria używana jest do rozpoznawania i oceny objawów fizjologicznych i patologicznych u noworodka. Pozwala także na stałą obserwację ważnych parametrów zdrowia noworodka oraz ocenę stopnia zagrożenia jego życia. Przeważnie leczenie w oddziałach intensywnej terapii może trwać nawet przez wiele miesięcy, więc monitorowanie powinno być pewne, bezpieczne i nieinwazyjne dla dziecka oraz proste i wygodne w użyciu.

**Słowa kluczowe:** Pulsoksymetria, podstawy, zastosowanie, neonatologia.

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## 1. Operation of pulse oximeter

LEDs emit different monitor light beams alternately at a frequency of several hundred times per second. The beams pass through the object (e.g. hand of a newborn). The optical sensor is placed on the skin surface, usually assumed to be on hand or foot of the newborn [4], [7] (Fig. 1). The photo-detector receives the weakened light energy at the appropriate wavelengths. With the photo-detector signal is subject to the analog and digital processing and the final result is on the LCD screen corresponding image. This is possible since the volume of blood changes in accordance with variations in the heart rate of the cardiac cycle, i.e. during systole, when the local blood volume and light absorption is the largest [6].

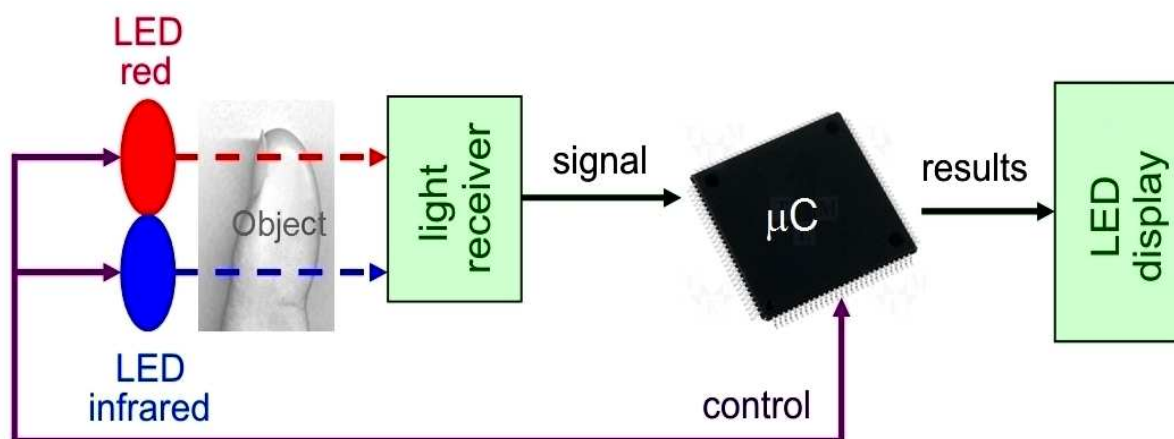


Fig. 1. Diagram of the pulse oximeter

Source: Elaboration of the Authors based on [4]

The oximeter measures the wave of light with two lengths. In the case of a high level of oxyhemoglobin ( $O_2Hb$ ) pulse oximeter measures the less red light, and the more infrared (high saturation), and for an increased number of deoxyhemoglobin ( $Hb$ ) - measures more red light and less infrared (low saturation) (Fig. 2) [1].

According to some authors [1], the ratio of red light to infrared light quantities, for example 100%  $SpO_2$  amounts to approx. 0.43 and for 85%  $SpO_2$  value is 1.0, and 0%  $SpO_2$  ratio is approx. 3.4. At 0% saturation is a big change in the signal beam of red and a small change in the signal of infrared rays, in contrast to the 100%  $SpO_2$ . Oxygen saturation of 85% results in more or less equal to the change in the signal.

## 2. Application of pulse oximetry in newborns

Commonly performed test for neonatal pulse oximetry is used to assess the percentage of oxyhemoglobin and pulse rate. Most often at the same time it is performed ECG, respiration and blood pressure. In newborn oxygen saturation above 85% is taken as the correct value [3].

Pulse oximetry has been used as a method for monitoring the condition of the newborn (especially preterm) [2] (Fig. 3):

- in disease states threatened by hypoxia (e.g. a respiratory disease, cardiovascular disease, sepsis, metabolic disorders),
- during the oxygen and mechanical ventilation,
- cases of apnea and hypoventilation [5],

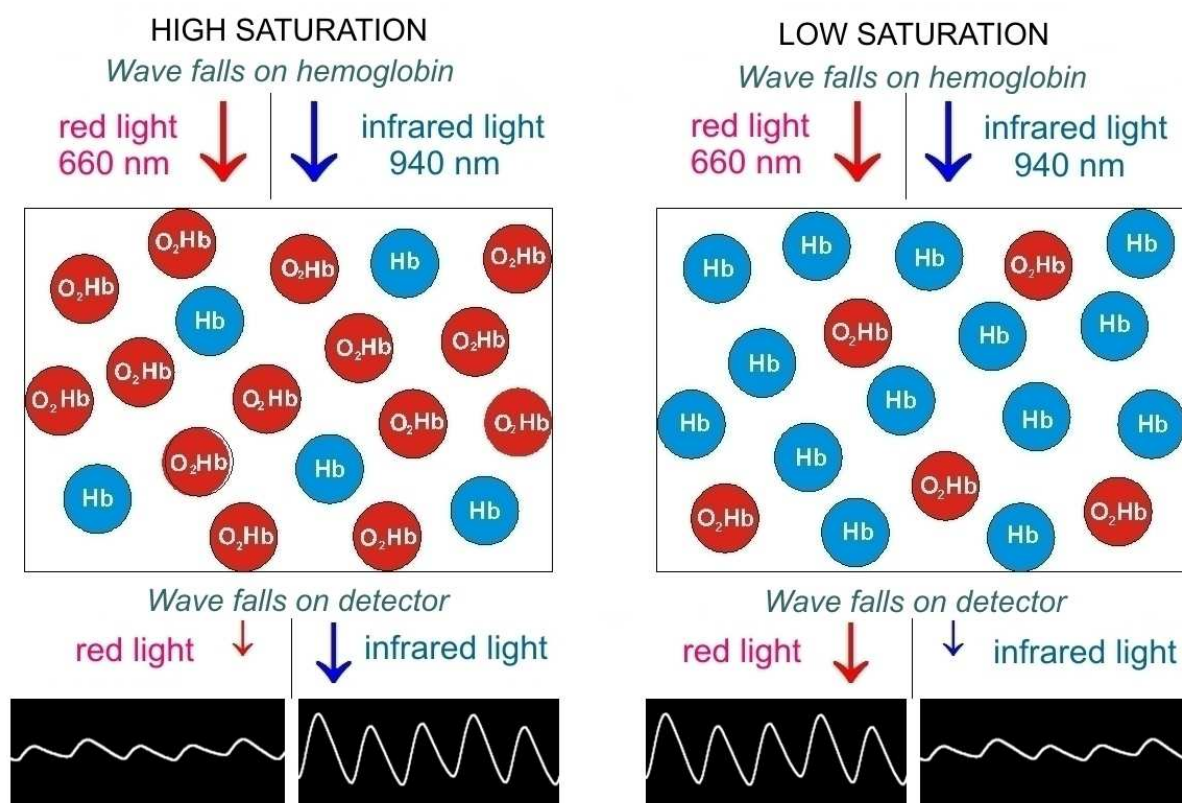


Fig. 2. Illustration of the effect of light on the wave signal saturation  
 O<sub>2</sub>Hb – oxyhemoglobin, Hb – deoxyhemoglobin  
 Source: Elaboration of the Authors based on [4]

- during surgery, diagnostic and therapeutic exertions,
- during the medical procedures (e.g. at the time of the bronchial tree in intubated children),
- as a screening test (e.g. in the direction of congenital heart defects)
- during resuscitation in the delivery room,
- as a test indicative to assess the state of oxygenation in children at risk hiperoksemią in oxygen and its complications (e.g. prematurity retinopathy) [2], [3].

Pulse oximetry has been used as a method for analysis of graphical and numerical status of newborns using hardware and specialized programs (e.g. *Mathematica*, *MathCAD*) (Fig. 4).

Comparative assessment of fetal pulse oximetry with computer cardiocography can be a method of forecasting the state of postnatal infant (newborn). A very important element of the use of pulse oximetry to assess the peripheral circulation [2], [8].

Pulse oximetry is a safe and non-invasive method generally used to monitor the status of the newborn in intensive care units [2], [3].



Fig. 3. Picture from *Infinity Vista XL* monitor by *Dräger-Medical* in newborns hall  
Source: From the Authors collection

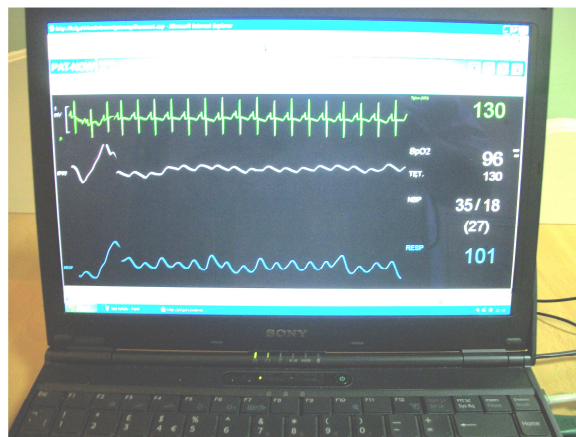


Fig. 4. Picture on computer monitor for numerical analysis of pulse oximetry curve  
Source: From the Authors collection

### 3. Conclusions

- Pulse oximetry is used to recognize and evaluate symptoms of physiological and pathological conditions of a newborn. It also allows for constant observation of important health parameters of the newborn and assessing the risk of his life.
- Special medical surveillance is indicated in preterm newborn infants especially extreme prematurity (born before 32 Hbd) due to the immaturity of the body.
- Mostly treatment in intensive care units can last for many months, so monitoring should be sound, safe and non-invasive to the child and simple and convenient to use. In newborns are common clinical circumstances where indicated to evaluate the oxygenation of arterial blood. Due to the immaturity of the respiratory system often occurs in newborns to respiratory disorders, the consequence may be the partial pressure of oxygen in arterial blood (hypoxemia), leading to hypoxia (hypoxia).

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