

# Pulse oximetry

Pulse oximetry **non-invasively measures the oxygen saturation of hemoglobin** in the arterial part of the bloodstream (pulsatile flow).

See *Pulse oximetry principles for more info*

The location of the detector is the **fingers of the limbs or the earlobes**. Due to the circulation time, a sensor placed on the earlobe detects changes earlier than a sensor placed on the toe. Leaving the transducer in one place for long periods of time runs the risk of tissue damage from pressure. In newborns, **physiologically lower values** are due to the presence of R-L shunts.

Interpretation of SaO<sub>2</sub> values during oxygen therapy

SaO <sub>2</sub> values	Clinical notes
Newborns after 10 minutes > 90 % infants over 1 month > 95 %	physiological values
< 92 %	indications for oxygen administration in healthy lungs
< 80 %	critical condition within tens of minutes
< 60 %	immediate critical desaturation

Immediately after birth, satisfactory saturation in the first min is from 60% upwards, in the fifth minute over 85%, in up to the tenth minute of life we expect 90% or more

## Relationship between SaO<sub>2</sub> and pO<sub>2</sub>

The relationship between PO<sub>2</sub> and SaO<sub>2</sub> is given by the **hemoglobin dissociation curve**. Due to its **axis-shaped course**, SaO<sub>2</sub> monitoring does not allow detection of changes in PaO<sub>2</sub> in the low and high range of values (SaO<sub>2</sub> values < 70% and SaO<sub>2</sub> values > 98%). Factors that affect the position of the hemoglobin dissociation curve also affect the SaO<sub>2</sub> value. These changes are significant only on the **steep part of the dissociation curve**.

In patients with normal pH and body temperature values, a SaO<sub>2</sub> value of 90% corresponds to a pO<sub>2</sub> of about 60-65 mm Hg (= 8-8.6 kPa). In clinically detectable cyanosis in patients without anaemia, SaO<sub>2</sub> parameters are usually already around 80%. Pulse oximetry does not correlate well with excessively high pO<sub>2</sub>, e.g. at a SaO<sub>2</sub> of 98% the pO<sub>2</sub> may be 10 or even 20 kPa and this is already toxic hyperoxia. This fact is particularly important in neonatology.

## Overview of the most common causes of artefacts in pulse oximetry

- Low perfusion of the measurement site → hypotension, low cardiac output, hypothermia;
- severe anemia;
- Excessive ambient light intensity;
- Incorrect sensor position;
- sensor movement;
- venous pulsation in the lower limb;
- high skin pigment content (blacks, tans, ...).

**The most common cause of artifact is the loss of pulsatile signal character during hyperperfusion of the monitored site.**

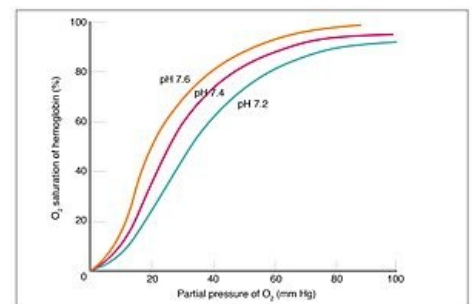
## Clinical notes on SaO<sub>2</sub> assessment

**Carbon monoxide intoxication** produces carboxyhaemoglobin (COHb), which has virtually the same ability to absorb light at 660 nm wavelength as oxyhaemoglobin, which is why standard oximeters give a falsely high SaO<sub>2</sub> value in the presence of COHb.

In **methaemoglobinaemia**, we detect a SaO<sub>2</sub> value of 85% because methaemoglobin has the same absorption coefficient for red and infrared light. Thus, methaemoglobinaemia leads to a falsely low SaO<sub>2</sub> value if its true value is greater than 85% and to a falsely high value if its true value is less than 85%.



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Dissociation curve of hemoglobin

In **anaemia**, we detect a high SaO<sub>2</sub> value relative to oxaemia, since erythrocytes are well saturated at low concentrations. Conversely, we detect falsely low SaO<sub>2</sub> values in polyglobulinemia.

In **hypoperfusion**, SaO<sub>2</sub> may be falsely low or high (→ if the pulse oximeter senses currently open AV shunts).

In **icterus** and **presence of dyes** in the body (methylene blue), we detect falsely low values, as well as when using nail polish.

**Arrhythmias** will cause irregularities in the waveform and therefore changes in the average measured saturation, a severe tricuspid defect by the mechanism of transmitted venous pulsation can cause errors in signal measurement.

## References

### Related articles

- Cardiopulmonary monitoring
- Principles of pulse oximetry

## Source

ŠEVČÍK, Pavel, et al. *Intenzivní medicína*. 3. edition. Galén, 2014. 1195 pp. pp. 179–183. ISBN 978-80-7492-066-0.

- HAVRÁNEK, Jiří: *Cardiopulmonary monitoring*.