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## Pulse Oximetry

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Pulse oximetry is the measurement of the percentage of haemoglobin in the blood that is saturated with Oxygen.

### Pulse oximeter

A pulse oximeter is a device for measuring Oxygen saturation in a casualty, without the need for invasive methods or chemical tests.

A pulse oximeter may be used whenever there is reason to question or monitor a casualty's Oxygen uptake, or when the effectiveness of treatment (eg. Oxygen therapy) is to be monitored.

### Pulse oximeter operation

The pulse oximeter is a device which can be attached to a finger (or toe), or earlobe. It includes a pair of light sources and detectors - one red, one infra-red. The light passes through the tissues where some of it is absorbed. The absorption is dependent on the amount of blood in the tissues and the Oxygen saturation of the haemoglobin in that blood. The light picked up by the detectors fluctuates along with the casualty's pulse; the Oxygen saturation can be determined from the relative high and low levels of the red and infra-red light. The absolute light levels are not included in the calculation, which means that a pulse oximeter is not affected by factors such as digit size, skin thickness, or nail thickness.

The reading for peripheral Oxygen saturation (SpO<sub>2</sub>), and of pulse rate, is presented on a digital display on the pulse oximeter. For first aid purposes, it is assumed that peripheral Oxygen saturation (SpO<sub>2</sub>) equates to arterial Oxygen saturation (SaO<sub>2</sub>).

### Use of a pulse oximeter

The casualty's permission to attach a pulse oximeter must be sought prior to use.

The casualty's pulse rate should be ascertained by palpation for comparison with the reading on the pulse oximeter.

Switch on the machine and allow it to perform any built-in self tests. Verify that these have passed.

Attach the pulse oximeter probe to a digit (normally to a finger), such that the sensing light passes through the tip of the digit. Alternatively, if the probe is designed for this, attach it to an earlobe.

After attachment, allow time for the readings to stabilise before making any judgements from them.

Where appropriate, readings should be taken at intervals and recorded.

Readings should be reported when handing over the casualty to other medical personnel.

### *Precautions during operation*

Care must be taken to avoid erroneous pulse oximeter readings:

- Casualty movement, especially of the hand being used for monitoring, must be avoided.
- The pulse oximeter must be shaded from high levels of ambient light, especially if fluctuating or flickering, as this will swamp the pulse oximeter's sensors.
- The pulse oximeter must not be held in place other than by its own mechanism, and must not be pressed against a hard surface such that abnormal pressure is applied to the digit being monitored.
- The casualty's circulation to the digit being monitored must not be impeded by, for example, a sphygmomanometer cuff, a tourniquet, or by simply applying excessive pressure to, or via, the pulse oximeter clip.

### Expected readings

In a healthy, uninjured person, the SpO<sub>2</sub> level should be towards 100%, and always above 95%. A lower reading indicates a level of hypoxia.

An SpO<sub>2</sub> reading of 95% or less is cause for concern - indicating the need for Oxygen therapy.

- An SpO<sub>2</sub> reading of 90% - 95% represents a level of hypoxia.
- An SpO<sub>2</sub> reading of 85% - 90% represents serious hypoxia.
- An SpO<sub>2</sub> reading of 85% or less represents critical hypoxia.

Note: Persons with chronic respiratory or cardiac disease may have a 'normal' SpO<sub>2</sub> reading which is below 95% - reflecting the severity of their condition.

Note: an SpO<sub>2</sub> reading of 95%-100% merely indicates that a casualty's blood is well saturated with Oxygen. It does not indicate that the casualty does not require additional Oxygen. The casualty's overall condition must be assessed to determine whether Oxygen therapy is indicated, or not.

## Limitations

A pulse oximeter is only one diagnostic and monitoring tool. Its readings may not be meaningful unless other signs are taken into consideration, for example:

- The history of the injury or illness.
- The casualty's general condition, respiratory rate and depth, pulse, and blood pressure.

A pulse oximeter may not give accurate readings under certain conditions:

- The casualty must have sufficient tissue perfusion for the pulse oximeter to detect a pulse. Conditions such as hypovolaemia, severe hypotension, cold, cardiac failure, some cardiac arrhythmias, peripheral vascular disease, oedema, may prevent accurate pulse oximeter operation.
- Nail varnish can prevent the sensing light passing through to the tissues. Wherever possible remove nail varnish prior to attaching a finger probe.
- Carboxyhaemoglobin and methaemoglobin absorb light as if they were oxyhaemoglobin, and thus lead to an over-estimate of the Oxygen saturation.
- Severe anaemia or elevated bilirubin levels may lead to inaccurate readings.
- The presence of intravascular dyes (used in some medical procedures) may lead to inaccurate readings.
- Skin pigmentation may affect the accuracy of readings.
- Grease and dirt can lead to poor operation of a pulse oximeter. They may also contaminate the devices light sources and sensors.
- An irregular heart rhythm may prevent a pulse oximeter from giving a valid reading.
- Shivering may prevent a pulse oximeter from giving a valid reading.
- Pulse oximetry in general does not give accurate readings much below Oxygen saturation levels of 85%.