Pulse oximeters have revolutionised anaesthesia monitoring because of their ease of use, rapidity of application, reliability as continuous, peripheral pulse monitors and their ability to non-invasively measure haemoglobin (Hb) saturation with O₂ (SpO₂). Pulse oximeters can detect problems in two main areas. First is hypoxia (lack of oxygen delivery to tissue), which is the most common cause of anaesthetic mortality; second are changes in pulse strength and regularity - commonly caused by lack of blood flow, bradycardia and dysrhythmias.

**Physiology**

Tissue O₂ Delivery = Blood Flow x Content of O₂  
Blood O₂ Content = Hb concentration x SpO₂ % + O₂ dissolved in plasma

Over 97% of the O₂ is carried on haemoglobin (Hb). Halving the PCV (40 to 20) halves the blood O₂ content but SpO₂ won’t change! O₂ binds to Hb in a sigmoidal relationship so arterial blood SaO₂ should be over 90% to stay above the steep decline on this curve, corresponding to a PO₂ > 60 to 65 mm Hg in dogs. Venous blood SvO₂ is typically 70 to 85%.

**Methodology**

Pulse oximetry is the continuous non-invasive monitoring of peripheral capillary bed SpO₂ via absorption of infrared light. The absorption characteristics of haemoglobin vary with oxygen saturation. The infrared light must be transmitted through skin or mucosa, subcutaneous tissue, bone and the blood volume filling the capillary bed (the total sum of which = “background absorption”), as well as the arterial pulsatile blood volume (used to determine SpO₂). Pulse oximeter SpO₂ readings decrease because of low Hb O₂ saturation (hypoxemia) or the background light absorption changes (lower blood flow).

**Interpretation of SpO₂ readings**

<table>
<thead>
<tr>
<th>SpO₂ (%)</th>
<th>Heart Rate (bpm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Small Dog</td>
<td>87-100</td>
</tr>
<tr>
<td>Large Dog</td>
<td>87-100</td>
</tr>
<tr>
<td>Cat</td>
<td>87-100</td>
</tr>
<tr>
<td>Horse</td>
<td>85-100</td>
</tr>
</tbody>
</table>

Alarm Settings

SpO₂ measured by a pulse oximeter is generally 2-3% lower than SaO₂ because it reads capillary blood through skin/mucosa. We aim to maintain arterial Hb O₂ over 90% so alarms are typically set at 85% to 87%.

Problem management

Low Perfusion

- Decrease in capillary blood volume (flow) altering background light absorption:  
  - vasoconstriction from painful stimulation  
  - consider analgesia  
  - poor perfusion caused by deep anaesthesia  
  - decrease anaesthesia  
  - increase IV fluids  
  - consider inotropes (e.g. dopamine or dobutamine)

- SpO₂ by mask  
  - tight fitting  
  - 95% from anaesthesia breathing circuits  
  - flow 100 to 200 ml/kg/min.

Test-drive a pulse oximeter

- Does it work effectively on cats?  
- Does it recognise alarm states?  
  - take probe off patient: see how long until it alarms  
  - cardiac arrest: test on a euthanasia patient  
- Is it user-friendly?  
- Probes wear out & are damaged:  
  - how much is a new one?  
  - what is the warranty?  
- Consider the power supply