

# Pulse Oximetry

Lydia Love, DVM, DACVAA

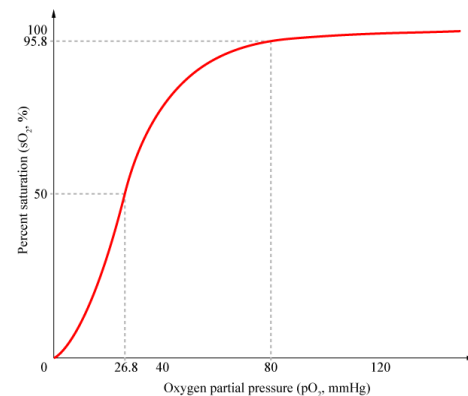
The pulse oximeter measures the saturation of hemoglobin (Hb) with oxygen ( $\text{SpO}_2$ ) and detects hypoxemia (reduced oxygen tension in the blood).

$\text{SpO}_2$  is estimated via the pulse-added differential absorption of two wavelengths of light:  
Hb that is attached to oxygen absorbs more light in the infrared band.  
Reduced Hb (no oxygen) absorbs light more readily in the red band.

**Normal pulse oximetry values during anesthesia with 100% oxygen should be 95% or greater, correlating with an arterial oxygen partial pressure ( $\text{PaO}_2$ ) of much greater than 100 mmHg.**

$\text{SpO}_2$  values that approach 90% indicate that  $\text{PaO}_2$  is around 60 mmHg.

The shape of the oxygen-hemoglobin dissociation curve is responsible for the relationship between  $\text{SpO}_2$  and  $\text{PaO}_2$ .



In addition to providing information about oxygenation, pulse oximeters rely on a detectable peripheral pulse and therefore also provide pulse rate and are an indirect measure of peripheral perfusion.

Pulse oximeters are notoriously fussy in veterinary patients and, because they tend to “cry wolf”, can be easy to ignore. Pulse oximeters may also exhibit a significant delay in detection of hypoxemia and they do not assess the adequacy of ventilation. A patient on 100% oxygen that is hypoventilating or even apenic may take several minutes to desaturate.

**Any reading below 95% deserves attention!**

Before assuming that the reading is spurious, check the mucous membrane color and capillary refill time of the patient. Ascertain the level of anesthesia (too deep?) and assess pulse quality and blood pressure.

There are five causes of hypoxemia that should be considered when the pulse oximeter indicates that oxygen saturation is low:

1. Decreased inspired oxygen concentration
2. Hypoventilation
3. Ventilation-perfusion (VQ) mismatch
4. Shunting of blood through the lungs without be oxygenated
5. Diffusion impairment

Differential diagnosis of hypoxemia: **Think: Patient? Or equipment?**

After checking the patient

Check the oxygen flow

Check the integrity of the anesthesia machine

Check the breathing circuit and all connections

Check the position of the endotracheal (ET) tube (tip at thoracic inlet?)

Check for the presence of ETCO<sub>2</sub> and waveform

Ventilate the patient by hand and auscult both sides of the chest for breath sounds

Consider thoracic radiographs

Consider an arterial blood gas

In a previously healthy patient, endobronchial intubation and machine errors are common causes of hypoxemia.

Patients with abnormal lung function, for example due to pneumonia, may need more aggressive attempts to maintain appropriate oxygenation by performance of recruitment maneuvers or application of positive end expiratory pressure (PEEP).