## 2.7 Pulse Oximeter

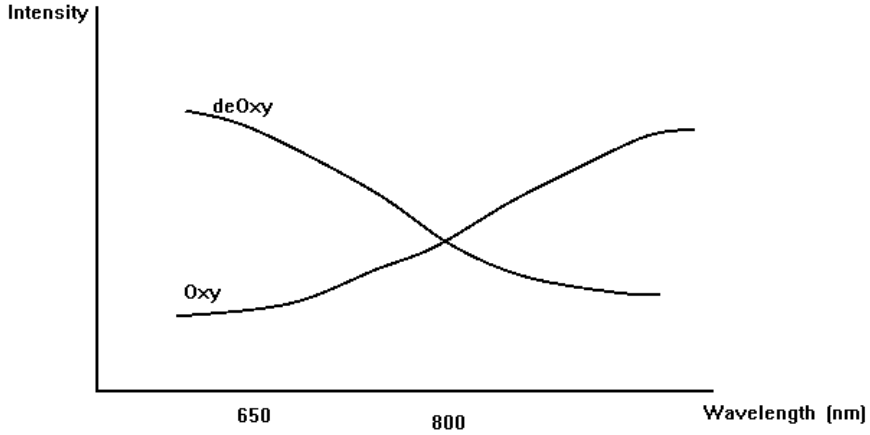
### 2.7.1 Clinical Use and Principles of Operation

Oximetry is a non-invasive method of measuring the oxygen saturation of the hemoglobin in the blood. The percentage of the hemoglobin that is saturated with four oxygen molecules is a good indicator of the oxygen carrying capacity of the blood. In a healthy human, nearly 100% of the hemoglobin is saturated all of the time in the arteries.

Most pulse oximeters display both the heart rate and the SpO2 – the oxygen saturation.


Modern oximetry is conducted with a pulse oximeter. The pulse oximeter uses the plethysmographic pulse from the artery to improve the measurement. Therefore, in addition to the oxygen saturation of the hemoglobin, the device also can report the heart rate and the plethysmograph, though the latter is less common.

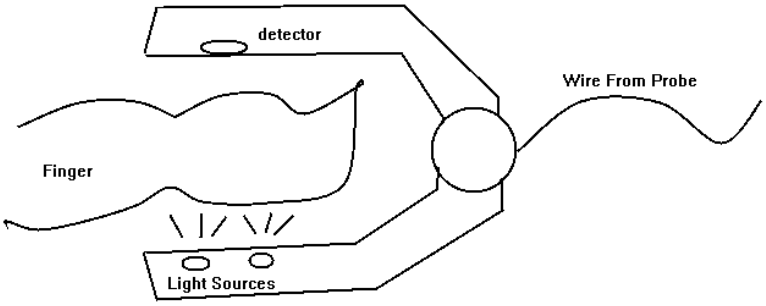
The pulse oximeter uses two frequencies of light impinging on the tissue. One of the two frequencies (or wavelengths) is sensitive to only the volume change (plethysmogram) and one which is sensitive to both the plethysmogram and the oxygen saturation. Figure 2.8.1 shows that at about 805 nm, the intensity of the light from the tissue does not depend on whether it is oxygenated or deoxygenated. Whereas, at 655 nm, there is a large difference in the amount of light reflected from the tissue. By carefully analyzing both signals, the device can deduce the oxygen saturation of the blood hemoglobin, usually simply reported as a percent (Sp02).




Careful analysis of the light from two wavelengths allows the pulse oximeter to determine the percentage of hemoglobin saturated with oxygen.

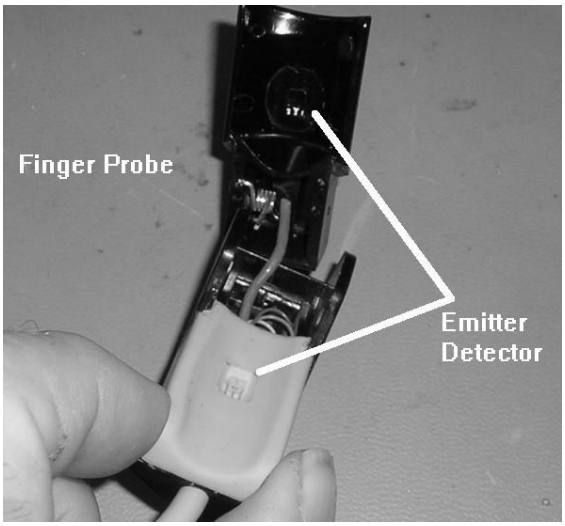
The probe, which contains both the light source and the light sensitive sensor, can be placed on a finger, ear lobe, toe or forehead depending upon its design. Some probes are single use while others are multi-use. Multi-use probes are preferred in the developing world. However, disposable probes are often reused.

The most common pulse ox probe contains two light sources (about 650 and 800 nm) and one detector that is multiplexed.




### 2.7.2 Common Problems

The most common problems with the pulse oximeter are related to the probe. The constant reuse of disposable probes eventually results in lead breakage. These can often be repaired, if only a single wire is broken. The second common problem is a missing probe. Unfortunately, it is not possible to substitute incompatible probes, as the wiring, and even the approach to producing and sensing the two wavelengths differ between manufacturers.




The most common probe for a pulse oximeter is the finger probe. Broken wires, springs and plastic cases are common problems that can be fixed in the field.

There are a few areas of user error which are common. Sensor placement is the most common. The sensor should be positioned to avoid letting ambient light enter the tissue or the sensor. Some nail polish will block light transmission. If the patient is cold the blood vessels may constrict making detection of blood flow difficult.

Beyond probe problems, typical power supply problems and user error (which is rare with this device), there is very little that can be done to repair a broken pulse oximeter.

### 2.7.3 Suggested Minimal Testing

A pulse oximeter can be easily tested on yourself. Your heart rate should be accurately reflected (to within 1 bpm) on the display as compared to a standard stop-watch/neck-artery technique. Also, check the alarms to assure that when your heart rate is outside of the set range, the alarms sound.