Hypoxia

Oxygen is carried in the blood in two ways:

1) Small pool in physical solution- measured by the arterial pO2
2) Majority bound to haemoglobin- measured as the oxygen saturation, which is the percentage of Hb with O2 attached

The oxygen in physical solution is in equilibrium with the bound oxygen, which allows for O2 release when in the tissues (where pO2 is low) and uptake from the lungs (where pO2 is high). The relationship between the two is described by the famous oxyhaemoglobin dissociation curve.

The pO2 is more sensitive to hypoxia than the haemoglobin saturation because of the flat part at the top of the curve. This means that the saturation will seem quite good (better than 90%) even though the pO2 has fallen from 14 to 8 kPA. For this reason, most clinicians start to become concerned when the saturation is 93%, which corresponds roughly with the start of the steep part of the curve. This saturation usually corresponds with a pO2 of about 10.

Saturation is conveniently measured using pulse oximetry SpO2, which uses the colour change of blood to help assess saturation. It is relatively cheap non invasive and convenient and usually corresponds quite well with the formal measurement on an arterial blood gas (abg) sample (SaO2).
However, SpO2 can sometimes be misleading:

- Patients with variant forms of haemoglobin (hb)
- Carbon monoxide poisoning (where pulse oximetry gives a falsely high level as it cannot easily distinguish carboxyhaemoglobin from oxy-hb)
- Poor pulse signal- nail varnish (see picture above), poor tissue perfusion etc

Remember that haemoglobin saturation with O2 says nothing about ventilation, which is best assessed by the pCO2 (Dakin et al. 2003).

The SpO2 is very useful, but should probably be supplemented with abg measurement if the saturation falls to 93% and the patient is sick.

Further reading: