Pulse Oximetry

Indications
- As part of a cardiovascular or respiratory assessment of a patient.
- Titration of oxygen delivery.

Contraindications
- None.

Caution
- Pulse oximeters do not instantaneously reflect changes in blood oxygenation (1).
- Can give false values in the presence of carboxyhaemoglobin and methaemoglobinaemia.
- Using probes in different anatomical areas or age groups than specified can result in significant measurement errors.

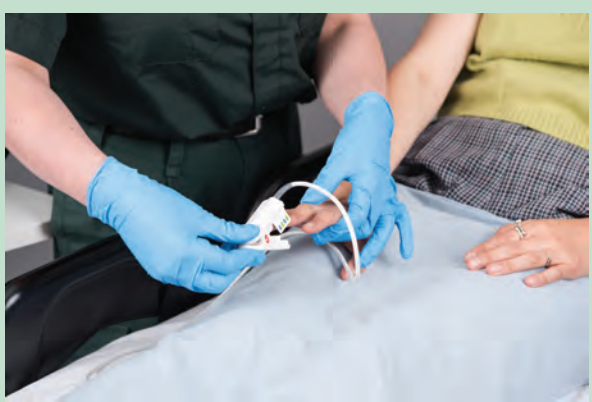
Advantages
- Non-invasive and easy to measure.
- Can assist in accurate titration of oxygen.
- Provides an estimate of arterial oxygenation.

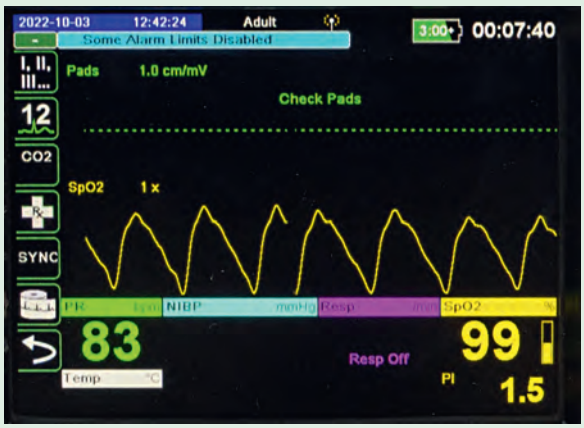
Disadvantages
- Not as accurate as invasive methods of measuring oxygenation.
- Does not provide sufficient information about adequacy of ventilation.
- Can give erroneous readings in cases of carbon monoxide poisoning (2) and methaemoglobinaemia (3), in the presence of poor peripheral perfusion, and during excessive motion (4,5).

Procedure – Record Oxygen Saturations with Pulse Oximetry

Take the following steps to record a patient's oxygen saturations with pulse oximetry (6):

Action		Rationale
1.	Explain the procedure and obtain consent if appropriate to do so.	You must make sure that you have valid consent from service users or other appropriate authority before you provide care, treatment or other services (7,8).
2.	Don appropriate personal protective equipment (PPE), and undertake appropriate hand hygiene.	This reduces the risk of cross-infection (9).
3.	Turn the pulse oximeter on. 	

Action		Rationale
4.	Select the appropriate probe with particular attention to correct sizing and where it will go (usually the finger, toe or ear). If used on a finger or toe, make sure the area is clean. Do not place probes designed for adults on babies or finger probes on ears, and vice versa. If present, consider removing nail varnish or rotating the probe by 90°.	Correct sizing and avoidance of excessive pressure will help obtain an accurate reading. Probes attached too tightly can lead to detection of venous pulsations and venous oxygen saturation presented as arterial blood oxygen saturation (SpO_2) (2). Using probes in different anatomical areas or age groups than specified can result in significant measurement errors (up to 50% lower or 30% higher) (10,11). Some dark-coloured nail varnish can affect the accuracy of pulse oximeters. However, if a consistent reading is obtained throughout, then this is probably accurate (12,13). Rotating the probe can alleviate this.
5.	Connect the probe to the pulse oximeter.	
6.	Position the probe securely and, if possible, avoid the arm being used for blood pressure monitoring. 	Cuff inflation will interrupt the pulse oximeter signal.

Action		Rationale
7.	Allow several seconds for the pulse oximeter to detect the pulse and calculate the oxygen saturation. Look for the displayed pulse indicator or waveform to indicate that the device has detected the pulse reliably. In addition, if your device can measure the perfusion index (PI), this should be above the manufacturer's minimum (1.0 for the X-Series (14)). If it is not, try another finger or limb. 	Without these signs, any readings may not be reliable (2,6).
8.	Once the unit has detected a good pulse, the oxygen saturation and pulse rate will be displayed. Like all machines, oximeters may occasionally give a false reading – if in doubt, rely on clinical judgement rather than the machine (15). You can check the pulse oximeter is working properly by placing it on your own finger (6).	
9.	Document your findings.	You must keep full, clear and accurate records for everyone you care for, treat, or provide other services to (8).

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Pulse Measurement

Indications

- As part of initial assessment to determine whether the patient is in cardiac arrest.
- Routine cardiovascular physiological assessment.

Contraindications

- None.

Advantages

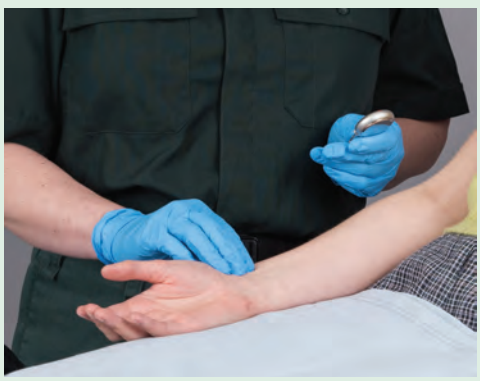
- Gives early indication of the adequacy of cardiac output.
- Greater accuracy when estimating the rate of irregular heart rhythms than electronic devices (if count conducted over 60 seconds).

Disadvantages

- Requires physical contact with the patient and the use of one hand, making other simultaneous activities difficult.
- Can take up to 60 seconds to perform accurately.

Procedure – Record a Pulse

Take the following steps to record a pulse:

Action		Rationale
1.	Explain the procedure and obtain consent if appropriate to do so.	You must make sure that you have valid consent from service users or other appropriate authority before you provide care, treatment or other services (1,2).
2.	Don appropriate personal protective equipment (PPE), and undertake appropriate hand hygiene.	This reduces the risk of cross-infection (3).
3.	Place your index and middle fingers (and your ring finger, optionally) along the artery and press gently. As a general rule for adults, palpate the radial pulse first in conscious patients and the carotid pulse first in unconscious patients. 	Avoid using your thumb as the arteries run along the palmar surface and may be palpable (4). Do not push too hard, or you will occlude the artery. Palpating a pulse at the wrist is less threatening than moving your hand towards the patient's neck! In unconscious patients, who may have a low BP, you will want to ascertain whether they have a pulse or not, and the carotid artery is generally the best place to determine this (although the femoral artery is also used).

Action		Rationale
		A patient who does not have a radial pulse but does have a carotid pulse is likely to have poor peripheral perfusion. However, it is not possible to accurately determine systolic blood pressure (BP) from the absence or presence of pulses (5,6).
4.	If the pulse has a regular rhythm, count for 15 seconds and then multiply by four. If the pulse is very fast or slow or irregular, then count for a full 60 seconds.	Counting for 60 seconds is most accurate but may not always be practical to achieve. Counting for 15 seconds will probably not result in a clinically important error, but expect an error of up to 5 beats per minute (bpm) in this case (7). Note: If you suspect a cardiac arrest, then pulse checks should be conducted for no more than 10 seconds (8).
5.	Document the procedure.	You must keep full, clear and accurate records for everyone you care for, treat, or provide other services to (2).

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Capillary Refill Time Measurement

Indications

- Part of the circulatory assessment of an infant or child.
- Suspicion of dehydration.
- Assessment of response to treatment.

Contraindications

- Very sick children where distress may lead to decline of current condition, for example life-threatening asthma.
- Low-ambient light makes accurate assessment diffcult (1).

Advantages

- Does not require equipment to perform.
- Provides some measure of circulatory adequacy when blood pressure measurement is not possible.

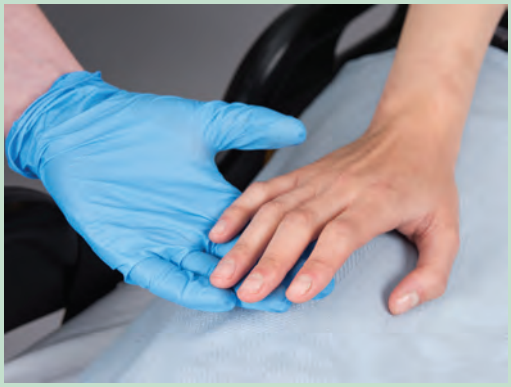
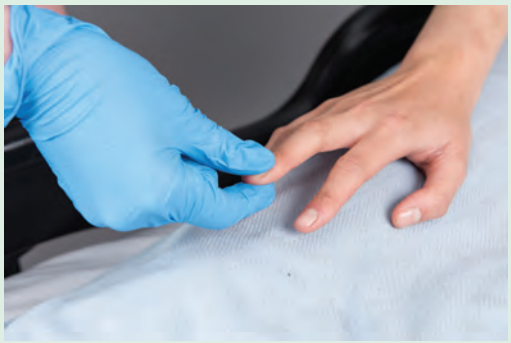
Disadvantages

- Sick infants or children can have a normal capillary refill time (CRT) (2).
- Does not predict mild-to-moderate hypotension in adults (3) and its usefulness in adults has been questioned (4).
- Accuracy affected by ambient temperature and light, the site and poor inter-observer agreement.

Procedure – Capillary Refill Time Measurement

Take the following steps to measure the CRT:

Action		Rationale
1.	Explain the procedure to the patient and the patient's caregiver (depending on age) and obtain consent if appropriate to do so.	You must make sure that you have valid consent from service users or other appropriate authority before you provide care, treatment or other services (5,6).
2.	Don appropriate personal protective equipment (PPE), and undertake appropriate hand hygiene.	This reduces the risk of cross-infection (7).
3.	Ensure the environment is warm and well lit. Choose one person to record all CRT measurements.	Cool or cold skin and poor lighting affect the accuracy of CRT measurement, as does having multiple clinicians recording CRT (1).

Action		Rationale
4.	Select either the upper part of the sternum (manubrium) or the fingertip pulp as the site for measurement. Site-specific advice: • Sternum: Place your index finger on the patient's manubrium. • Fingertip: Place the fingertip pulp between your thumb and index finger and hold the hand at the level of the patient's heart (8). 	The sternum is generally a convenient site for children, and recording a CRT in small fingers can be a challenge. However, sternal CRT is difficult to assess in infants and children with darker skin tone (9). There is poor correlation between sternal and fingertip CRT, so do not use them interchangeably (9).
5.	Provide sufficient pressure to make the tip of your nail blanch (turn pale) (10). Press for 5 seconds. 	There is no universal agreement about the time pressure should be applied for, but 5 seconds is commonly reported (8–12).

Action		Rationale
6.	Remove the pressure and immediately count aloud how long it takes for the skin to return back to the pre-test colour.  	The time in seconds will be the patient's CRT.
7.	Consider repeating steps 4–5 and then average the results.	This may improve the accuracy of the result (10).
8.	Document the procedure. A normal CRT is 2–3 seconds. A CRT of more than 3 seconds in a child is clinically important (2).	You must keep full, clear and accurate records for everyone you care for, treat, or provide other services to (6).

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