



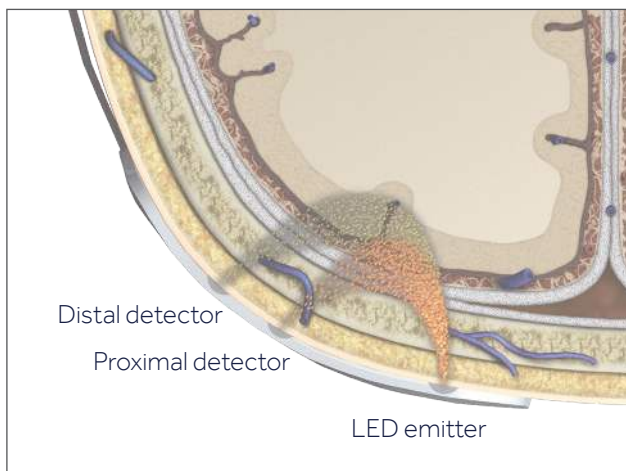
PEDIATRIC MONITORING IN-SERVICE GUIDE

INVOS™ cerebral/somatic oximetry system

Medtronic
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INVOS™ technology — a window to perfusion adequacy

The noninvasive INVOS™ cerebral/somatic oximetry system reports the venous-weighted regional hemoglobin oxygen saturation (rSO_2) in tissue under the sensor keys, reflecting the hemoglobin-bound oxygen remaining after tissues have taken what they need. Decreases in this venous reserve indicate increased ischemic risk and compromised tissue perfusion.



The INVOS™ system uses two depths of light penetration to subtract out surface data, resulting in a regional oxygenation value for deeper tissues.

Clinical characteristics of regional oximetry versus other oximetry

Regional (capillary) oximetry (rSO₂)

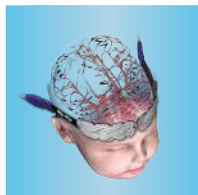
- Is noninvasive
- Uses a capillary (venous and arterial) sample
- Measures the balance between O₂ supply and demand beneath the sensor
- Alerts to changes in end-organ oxygenation and perfusion
- Requires neither pulsatility nor blood flow

Pulse (arterial) oximetry (SpO₂)

- Is noninvasive
- Uses an arterial sample
- Measures O₂ supply in the periphery
- Measures systemic oxygenation
- Requires pulsatility and blood flow

Central (venous) oximetry (SvO₂)

- Is invasive
- Uses a venous sample
- Measures O₂ surplus in central circulation
- Systemic oxygen reserve
- Requires blood flow



Key terms

rSO₂: regional oxygen saturation

INVOS™ system: in vivo optical spectroscopy

Cerebral application: brain area measurement

Somatic application: tissue area of measurement

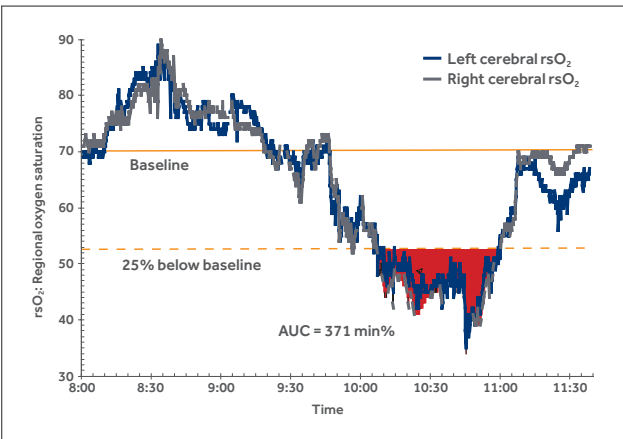
Pediatric rSO₂ targets and thresholds

Targets and thresholds are expressed in rSO₂ numerical values and percent changes from baseline. Both measures have been proven to provide real-time data accuracy in patients >2.5 kg. With the patient serving as his/her own control, you can customize patient assessment, decision making, and interventions based on each patient's unique physiology and clinical situation.

Cerebral — high blood flow, high O₂ extraction:²

- Typical rSO₂ range is 60 to 80.
- Common intervention trigger is rSO₂ <50 or 20% change from rSO₂ baseline.
- Critical threshold is rSO₂ <45 or 25% change from rSO₂ baseline.

rSO₂ Changes²

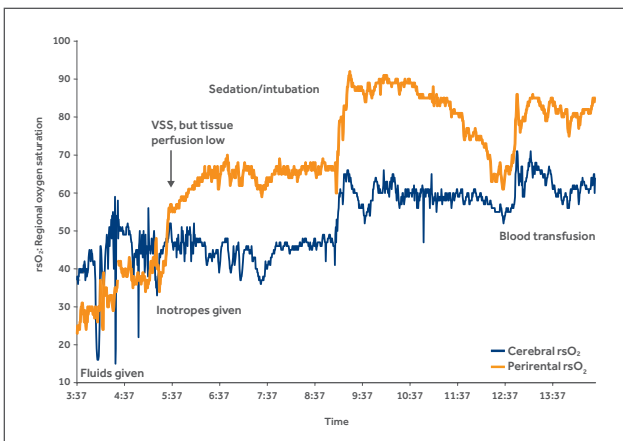


When rSO_2 is used as an indication of compromised cerebral oxygenation, interventions to return rSO_2 to baseline using the INVOS™ system have been shown to improve outcomes after surgery in patients >2.5 kg.¹

Somatic/perirenal — variable blood flow, lower O_2 extraction:

- Perirenal rSO_2 is 5 to 20 points higher than cerebral.
- Variances in the cerebral-somatic relationship may indicate pathology.

Reversal of shock³



Factors affecting rSO₂

The rSO₂ value may be affected by a host of variables in conjunction with the patient's condition. Variables include:

- Body positioning
- Muscular activity
- Circulating blood volume
- Cardiac function
- Peripheral vascular resistance
- Circulating hormones
- Venous pressure

While each hospital will have its own care protocols, the following guidelines have been shown to improve rSO₂.

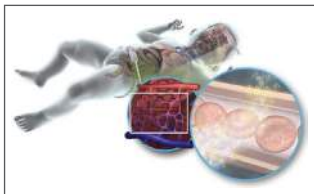
OR interventions to improve rSO₂ values⁴

Correct perfusion imbalance:

- Correct blood pressure
- Check for mechanical obstruction (cannula or head position)
- Increase cardiac output (pump flow)
- Increase circulating volume
- Increase CO₂ to physiologic levels

Correct deoxygenation:

- Increase FiO₂
- Increase hematocrit
- Reintubate



Increase ischemia tolerance:

- Increase anesthetic depth
- Administer a neuroprotective agent
- Provide additional cooling

In neonates, infants and children, cerebral and somatic rSO_2 provide noninvasive indications of oxygen changes in the cerebral and peripheral circulatory systems and may provide an early indication of oxygen deficits associated with impending shock states and anaerobiosis.¹

PICU interventions to improve cerebral rSO_2 values^{5,6}

Increase cerebral perfusion pressure:

- Increase blood pressure
- Increase systemic vascular resistance
- Increase cardiac output
- Decrease central venous pressure

Increase arterial oxygen content:

- Transfuse red blood cells
- Raise arterial partial pressure of oxygen

Reduce cerebral metabolic rate:

- Control hyperthermia
- Sedation

Reduce cerebral vascular resistance:

- Raise arterial partial pressure of carbon dioxide

PICU interventions to improve somatic rSO_2 ^{4,7,8}

Interventions to improve cardiac output:

- Cardiac output = stroke volume x heart rate

- Preload
- Afterload
- Contractility
- Heart rate and rhythm

Increase hematocrit

Maintain normal temperature



Figure 1 - INVOS™ 5100C system connections

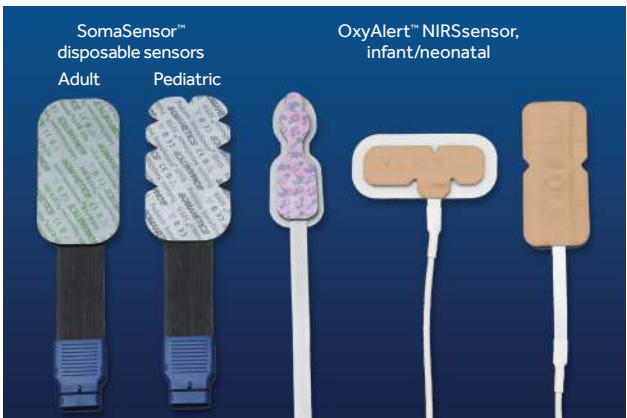


Figure 2 - INVOS™ system sensors

Setup and baselines

- Attach Sensors to reusable sensor cables (Figure 1). (Sensor cable can be connected to sensors before or after placement). Different INVOS™ system sensors (adult, pediatric, and infant/neonatal) cannot be used on the same monitor (Figure 2).
- Turn on power by selecting the green ON/OFF key. The INVOS™ system performs a 10-second self-test, stopping at the Start screen.
- Press NEW PATIENT. Monitoring begins displaying the patient's rSO₂ values in white.
- When the patient's rSO₂ values have been displayed for approximately 1 minute, set a baseline. For all channels, press the BASELINE MENU, then press SET BASELINE.

For extended monitoring, or if adhesive is inadequate to seal the sensor to the skin, apply a new sensor every 24 hours.

Sensor removal

Use care when removing the sensor from the patient. If difficult to remove, commercially available solvents include:

Uni-Solve™ adhesive remover, Smith & Nephew, 800-876-1261, global.smith-nephew.com

Detachol™ adhesive remover, Ferndale Laboratories, Inc., 248-548-0900, ferndalelabs.com

3M™ remover lotion, 3M Health Care, 800-228-3957, 3m.com



For complete instructions, warnings, and precautions, see the operations manual and instructions for use inside the sensor carton.

Site selection

Cerebral

Select the sensor site on the right and left side of the forehead. Placement of the sensor in other cerebral locations, or over hair, may cause inaccurate readings, erratic readings, or no readings at all. Do not place the sensor over nevi, sinus cavities, the superior sagittal sinus, subdural or epidural hematomas, or other anomalies such as arteriovenous malformations, as this may cause readings that do not reflect brain tissue or no readings at all.

To avoid pressure sores, do not apply pressure (e.g., headbands, wraps, tape) to the sensor.

Somatic

Select the sensor site over the tissue area of interest (site selection will determine which body region is monitored). Avoid placing the sensor over thick fatty deposits, hair, or bony protuberances. Do not place the sensor over nevi, hematomas, or broken skin, as this may cause readings that do not reflect tissue or no readings at all. When two somatic site sensors are placed, they must be connected into the same preamplifier.

Placements may include but are not limited to: renal area: posterior flank (T10-L2, right or left of midline), abdomen, forearm, calf, upper arm, chest, and upper leg.

Patient preparation

To prepare the patient:

- Clean the skin. Dry thoroughly.
- Remove protective backing and apply to skin.
- Apply the sensor by smoothing it to the skin from the center outward.



Figure 3. Examples of sensor placements: A, cerebral; B, perirenal; and C, abdominal

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