EDUCATIONAL MATERIAL
Carbon Monoxide Evaluation using Rad-57 Pulse CO-Oximeter

Objectives:

Following completion of this training, providers will be able to:

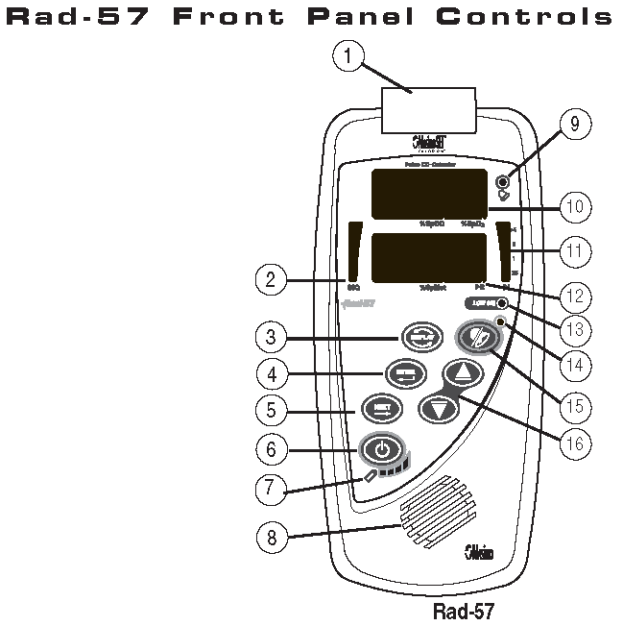
- Recognize the indications for carbon monoxide monitoring in the prehospital setting
- Utilize the Rad-57 hand held monitoring device to monitor carbon monoxide
- Interpret CO values as a screening measure for the prehospital treatment of carbon monoxide exposures

Resources:

- Rad-57 Rainbow SET Pulse CO-Oximiter
- Rad-57 Rainbow SET Pulse CO-Oximiter Operators Manual

Didactic Topics:

Section #1: Control and Indicator Descriptions



1. Patient Cable Connector: Connects to an appropriate Masimo Sensor or Patient Cable.
2. SIQ Bar: The Signal IQ provides an indication of the quality of the acquired signal as well as the timing of the pulse. A green vertical LED bar rises and falls with the pulse, where the height of the bar indicates the quality of the signal.
3. Display Button: Press to display the parameters/measurements selected in the Setup Menu screens.

4. Enter Button: Used to enter the setup menus and to select/activate certain entries within the menu / setup system.
5. Next Button: Used within the menu / setup system to move through setup options. Not active when default screen displays.
6. Power On / Off: Press to turn the Instrument on. Press-and-hold for 2 seconds to turn the Instrument off.
7. Battery Level Indicator: Four LED's indicate the status of the battery. When the final indicator begins flashing, replace the batteries.
8. Speaker: Provides audible indication of alarm conditions, pulse tone and feedback for key-presses. Ensure the speaker is not covered or the Instrument is placed face-down on bedding or other sound absorbing surface.
9. Visual Alarm Indicator: Illuminates when any alarm condition exists. This indicator may not be turned off or otherwise over-ridden.
10. Parameter / Measurement Value Display and Indicator: Displays parameter / measurement numeric values and indicates parameter / measurement label.
11. PI Bar: The Perfusion Index provides an indication of the percentage of pulsatile signal to non-pulsatile signal. The bar is highest when the quality of the perfused site is best.
12. Parameter / Measurement Value Display and Indicator: Displays parameter / measurement numeric values and indicates parameter / measurement label.
13. Low SIQ: Flashes to indicate low Signal IQ.
14. Alarm Silenced Indicator: The indicator can flash or be solidly illuminated.
15. Alarm Silence Button: Push once to temporarily silence the alarm for 120 seconds. Push a second time to return the Instrument to standard alarm monitoring.
16. Up button / Down button: During saturation monitoring, use these buttons to adjust the volume of the pulse beep tone. Within the menu / setup system, these buttons are used to select values within each menu option.

Section #2: Instructions for Use

1. Inspect the Rad-57 case for damage.
2. Connect a compatible patient cable or a direct connect sensor to the Rad-57. Make sure it is a firm connection and the cable is not twisted, sliced or frayed.
3. If utilizing a patient cable, select a sensor that is compatible with the Instrument and the patient before connecting it to the cable. If using a single patient adhesive or disposable sensor check that the emitter (red light) and the detector are properly aligned. Remove any substances that may interfere with the transmission of light between the sensor's light source and detector. Follow the Indications, Instructions and Cautions in the sensor's Direction for Use when attaching, reattaching or disconnecting the sensor(s).
4. Press the Power button to turn the Rad-57 on.
5. Verify all front-panel indicators momentarily illuminate and an audible tone is heard.

6. Verify the front-panel display is free of alarm and system failure messages, and the battery indicator shows sufficient charge.
   NOTE: "- - - "will show on the numeric display until the readings have stabilized (typically less than 20 seconds for SpO2 and up to 120 seconds for SpCO).
7. To begin patient monitoring:
   - Adjust the alarm limits.
   - Adjust the alarm volume.
   - Adjust the pulse beep volume.
8. Verify the sensor is applied correctly and that the measured data is appropriate
9. Monitor the patient.
10. After monitoring is complete, remove the sensor from the patient and store or dispose of the sensor according to governing rules. See the Directions for Use of the sensor.
11. Press and hold the Power On/Off button for 2 seconds to turn the oximeter off.

Successful Monitoring

The following general points will aid in ensuring oximetry monitoring success:

- Place the sensor on a site that is not too thick, has sufficient perfusion and provides proper alignment of the LED's and photodetector.
- Place the sensor on a site that has unrestricted blood flow.
- Do not secure a sensor with tape.
- Do not select a site near potential electrical interference (electrosurgical unit, for example)
- Read the sensor's Directions for Use for proper sensor application

Inaccurate measurements to may be caused by:

- Externally applied coloring (such as nail polish)
- Elevated levels of bilirubin
- Severe anemia
- Low arterial perfusion
- Motion artifact
- Intravascular dyes such as indocyanine green or methylene blue
- Arrhythmias
- Intra-aortic balloon support

Section #3: Treatment Considerations:

1. A SpCO reading is to be used as a screening measure. Definitive carboxyhemoglobin determinations are performed via blood draw in the hospital setting. Any patient with suspected carbon monoxide poisoning should receive oxygen by a non-rebreather mask until their CO level can be determined.
2. Any patient with airway compromise, respiratory distress, or symptoms of significant carbon monoxide poisoning (nausea, vomiting, loss of judgment, chest pain, dizziness, muscle weakness, or a change in

mental status) should be treated according to local protocols and transported to an emergency department regardless of the SpCO reading.

3. Pregnant women are at high risk in carbon monoxide exposure. The fetus is highly susceptible and the SpCO may be 10-15% higher than maternal readings. All pregnant women with possible CO exposure should be transported to the emergency department for evaluation.
4. Any patient with a SpCO reading >12%, even if without symptoms, should be transported to an emergency department.
5. Any patient with a SpCO reading >25%, even if without symptoms, NEEDS to be transported to an emergency department.
6. Patients with carbon monoxide exposure and SpCO <25% may be treated and released after considering the following conditions:
    - The patient is asymptomatic.
    - The patient exhibits no signs of respiratory distress, and pulse oximeter reading is above 92%.
    - The SpCO is below 5% in non-smokers, and 10% in smokers.
    - The lungs are clear on auscultation.
    - There are no other significant burns or traumatic injuries.
    - The patient has medical decision making capacity.
7. Use of the Rad-57 and serially recorded SpCO levels should be documented accordingly in a Prehospital Care report. It cannot be emphasized enough that the patient's clinical presentation is what should drive routine medical care and not the SpCO level observed. If there is ever doubt regarding the patient's disposition, provide high flow oxygen and transport to the hospital for evaluation.

Recommended Skills Demonstration:

- Demonstrate the correct operation and placement of the Rad-57 Pulse CO-Oximeter on a simulated patient
- Verbalize no less than three (3) causes of inaccurate measurements/readings
- Verbalize treatment considerations for patients with the following SpCO readings:
    - SpCO < 12%
    - SpCO > 12% and <25%
    - SpCO >25%

REFERENCE MATERIALS

Basic Menu Operations:

This section gives an overview of the Rad-57 menu selections available. To navigate through the menus, use the Enter, Next, Up and Down keys located on the front panel of the Pulse CO-Oximeter, below the LED display. There are several sub sections in each menu which are not described in detail. Additional information about these menus can be located in the Operators Manual, but are likely outside the scope of normal operation.

BUTTON	FUNCTION
	Pressing this button will cycle through the numeric values of the enabled parameters/ measurements. ***NOTE:*** *If any parameter/measurement breaches its pre-set alarm limit, the Rad-57 will automatically display the alarming parameter/measurement. Pressing* **Display** *during an alarm condition will enable the display of other parameters for 10 seconds.*
	Enters the Rad-57 setup/menu system. Refer to *Setup Menus* in this Section for details.
	Press to navigate through submenus.
	Press once to temporarily silence the alarm for 120 seconds or to acknowledge low battery or sensor off conditions. Press a second time to return the Instrument to standard alarm monitoring.
	During normal patient monitoring, the "Up" and "Down" Arrow keys control the Pulse Tone volume. At the lowest setting, the pulse tone is muted. A low-pitch tone indicates the highest or lowest setting has been reached. In the setup/menu system, the "Up" and "Down" Arrow keys select among the options for each setting.
	Power "on/off" button. Press this button to turn the Instrument on. Press-and-hold for 2 seconds to turn the Instrument off.

Alarm or Message Indicators:

DISPLAY	REASON	SOLUTION
NUMERIC VALUE FLASHES	Parameter alarm	Assess /address patient condition. Re-set alarm limits if indicated.
NO SEN	No Sensor Connected	Connect sensor to cable.
SEN OFF	Sensor off patient	1. Reattach sensor to patient. 2. Verify proper sensor placement.
02 SEN	SpO_2 sensor attached	If SpHb, SpCO and/or SpMet parameters are desired, attach a Rainbow sensor to the Instrument.
LEDS FLASH HORIZONTAL BARS	Pulse Search	Wait for pulse detection. (This search should occur whenever a sensor is first applied to a patient). If necessary, shield the sensor from excessive ambient or strobing light.
CIRCULATING LEDS	Sensor is calibrating	
LOW SIQ INDICATOR FLASHES	Low Signal IQ	1. Rule out occlusion of blood flow. 2. Verify placement of sensor.
PERFUSION INDEX (PI) BAR* TURNS RED (Bottom two LEDs only.)	Low Signal Strength	1. Rule out occlusion of blood flow. 2. Attempt to warm patient. 3. Move sensor to better perfused site. ***NOTE:*** *Masimo recommends using an adhesive sensor whenever low perfusion is expected or evident.*
SINGLE BATTERY LEVEL INDICATOR FLASHES (WITH AUDIBLE ALARM)	Battery level too low	Replace batteries immediately.
NO CBL	No Cable Connected	Connect appropriate cable to Instrument.
ERR ##	System Fault	Return for service. There are several error codes. All error codes require return of the instrument to an authorized service center for repair.
rPL CbL	Defective Cable	Replace cable
InC Sen	Incompatible sensor Unrecognized sensor	Insert Masimo sensor
InC CbL	Incompatible sensor Unrecognized cable	Insert Masimo sensor

Troubleshooting:

The following chart describes what to do if the Rad-57 system does not operate properly or fails:

PROBLEM	POSSIBLE CAUSE(S)	RECOMMENDATION
INSTRUMENT DOES NOT POWER ON	Depleted battery	Check and/or replace the batteries.
CONTINUOUS SPEAKERTONE	Internal Failure	Instrument requires service. Press the Alarm Silence button to silence the alarm. If alarm continues to sound, power down Instrument and remove Handheld battery if necessary.
BUTTONS DON'T WORK WHEN PRESSED	Internal failure	Instrument requires service.

The following chart describes what to do when encountering common problems:

PROBLEM	POSSIBLE CAUSE(S)	RECOMMENDATION
NUMERIC VALUE FLASHES	Saturation alarm limit exceeded.	Assess/address patient condition. Re-set alarm limits if indicated.
SENSOR OFF MESSAGE	Sensor not connected to patient properly. Sensor is damaged.	Properly reapply the sensor on the patient and reconnect the sensor to the Instrument or patient cable. If the sensor is damaged, replace the sensor.
NO SENSOR MESSAGE	Sensor is disconnected from patient cable. Sensor connected upside down into patient cable.	Check to see if the sensor LED is flashing. Disconnect and reconnect the sensor. If the LED fails to operate, replace the sensor.
LOW PERFUSION	Improper sensor type. Poorly perfused site. Sensor is too tight. A disorder such as hypothermia, vasoconstriction, hypovolemia, peripheral vascular disease or anemia. Sensor is damaged.	Verify proper sensor and sensor size for the patient. Check and see if blood flow to the site is restricted. Be sure that the sensor is not on too tight. Set Instrument to MAX sensitivity. Warm the patient or sensor site. Move sensor to better perfused site.
LOW SIGNAL QUALITY	Improper sensor type or application. Excessive motion relative to perfusion. Sensor is damaged or not functioning.	Check and see if blood flow to the site is restricted. Check the placement of the sensor. Re-apply sensor or move to a different site.