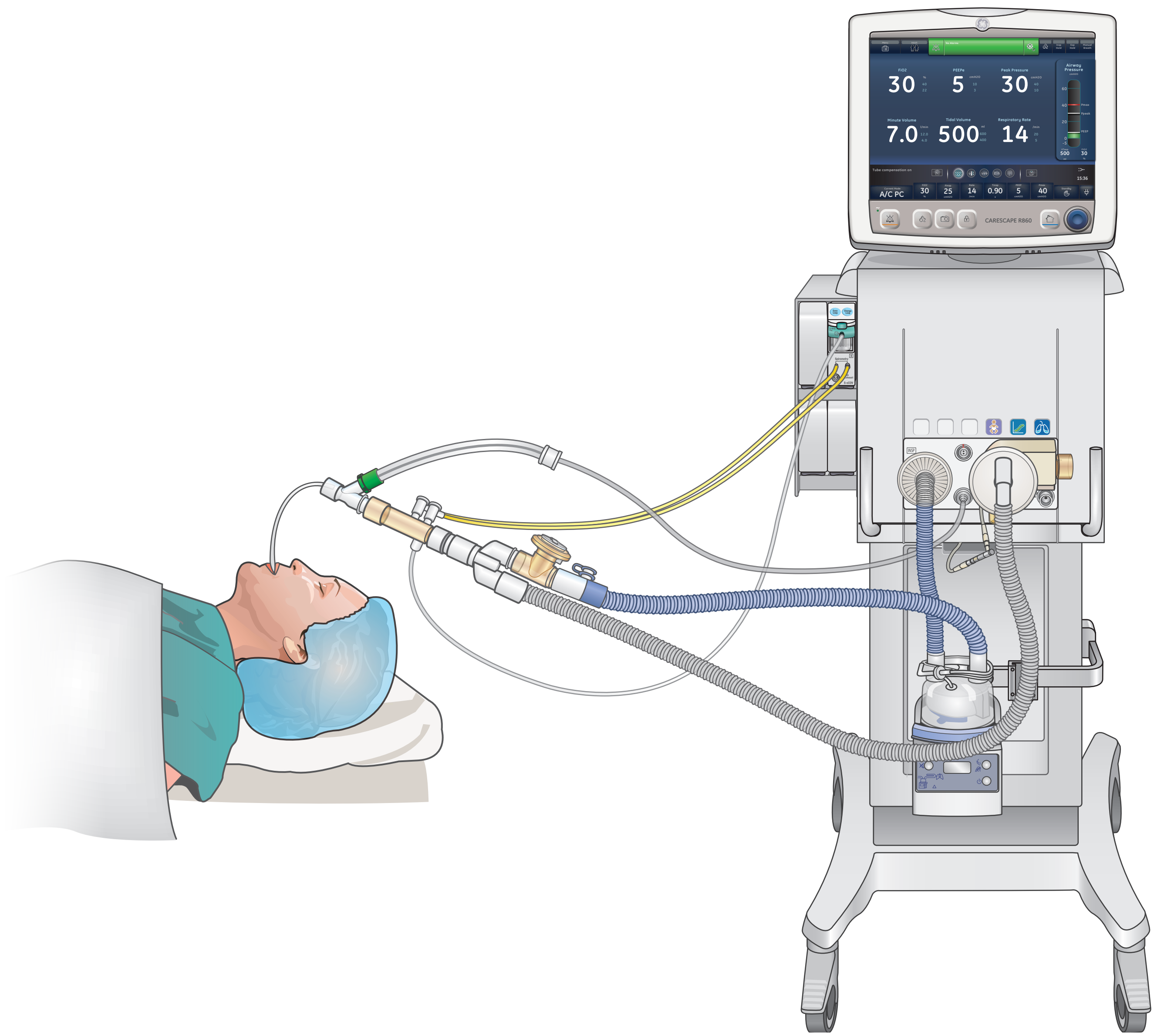
Quick Reference Guide

CARESCAPE R860 Indirect Calorimetry



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Contents

Notice

The materials contained in this document are intended for educational purposes only. This document does not establish specifications, operating procedures or maintenance methods for any of the products referenced. Always refer to the official written materials (labeling) provided with the product for specifications, operating procedures and maintenance requirements.

Indirect Calorimetry

Feeding critically ill patients can be challenging because acute illnesses can stress a patient's metabolism and make it difficult to anticipate their caloric needs. When a patient suffers from malnutrition, they can become dependent on the ventilator. This means they will be in the hospital longer, which increases morbidity and mortality as well as costs.

According to the SCCM and ASPEN 2016 Guidelines for the Provision and Assessment of Nutrition Support Therapy in the Critically Ill Patient, "Indirect Calorimetry should be used to determine energy requirements when available.[1]"

Indirect Calorimetry (IC) uses expired and inspired carbon dioxide and oxygen measurements to accurately calculate energy expenditure. The goal in measuring inspired O_2 (VO_2) and expired CO_2 (VCO_2) is to calculate the Resting Energy Expenditure (EE) and the Respiratory Quotient (RQ).

IC is helpful in the following scenarios:

- when you can't estimate caloric requirements
- when predictive equations produce an inadequate clinical response in a patient
- when the patient has clinical signs that suggest over or under feeding

The following equations are used by the CARESCAPE R860 to calculate EE from the measured VCO_2 and VO_2 (modified Weir equation):

$$\text{EE adult (kcal/day)} = 5.5\text{x } VO_2 \text{ (ml/min)} + 1.7\text{x } VCO_2 \text{ (ml/min)} - 2 \text{ x UN (g/day)}$$

$$\text{EE pedi (kcal/day)} = 5.5\text{x } VO_2 \text{ (ml/min)} + 1.7\text{x } VCO_2 \text{ (ml/min)}$$

$$RQ = VCO_2/VO_2$$

UN = Urinary Nitrogen (N2) output assumed at 13 g/day associated with protein consumption

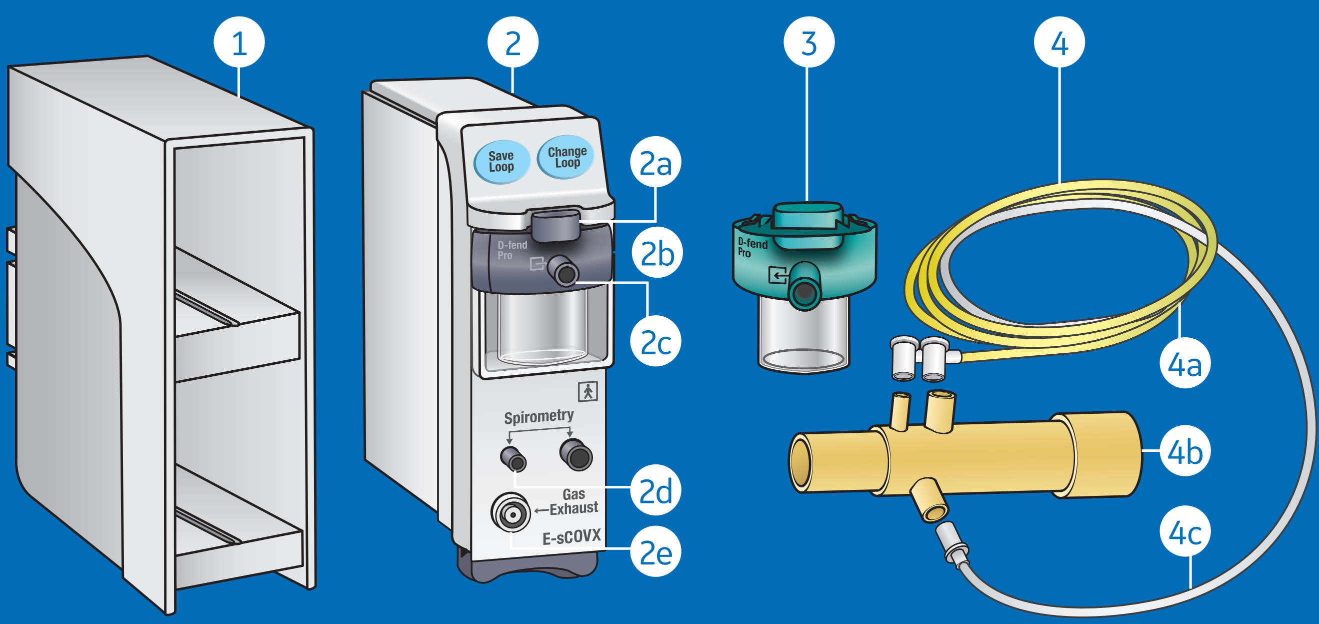
The fact that this method is indirect introduces several limitations which need to be well understood. Every clinician using IC should understand and account for its limitations, before reporting and interpreting results.

Note! Always refer to the User Reference Manual before use.

Limitations of Indirect Calorimetry on the Ventilator

- Leaks in the ventilator circuit, or around the artificial airway, or parenchymal leaks in the lung from fistulas, pneumothorax or chest drains etc, will affect the IC measurement. For this reason, measuring a patient ventilated in NIV (noninvasive mode) via a mask or other NIV interface is not advisable.
- Blood filtration, such as intermittent hemodialysis or peritoneal dialysis, will affect IC accuracy due to removal of CO_2 across the membrane.
- IC cannot be performed in the presence of N_2O. Please note that the elimination of N_2O from the body and also from diffusion is not immediate and patients should not be measured during or within 3 to 4 hours of anesthesia involving N_2O. In general, IC measurements should not be performed if any other gases apart from Air/O_2 are present at the airway.
- FiO_2 should be < 85% and should be constant.
- Maximum breath rate for IC to work properly is 35 bpm.
- If a D-lite sensor is used, minimum tidal volume should be 200 mls. For volumes less than 200 mls, the use of Pedi-lite is required. Minimum tidal volume limit for Pedi-lite is 15 mls.

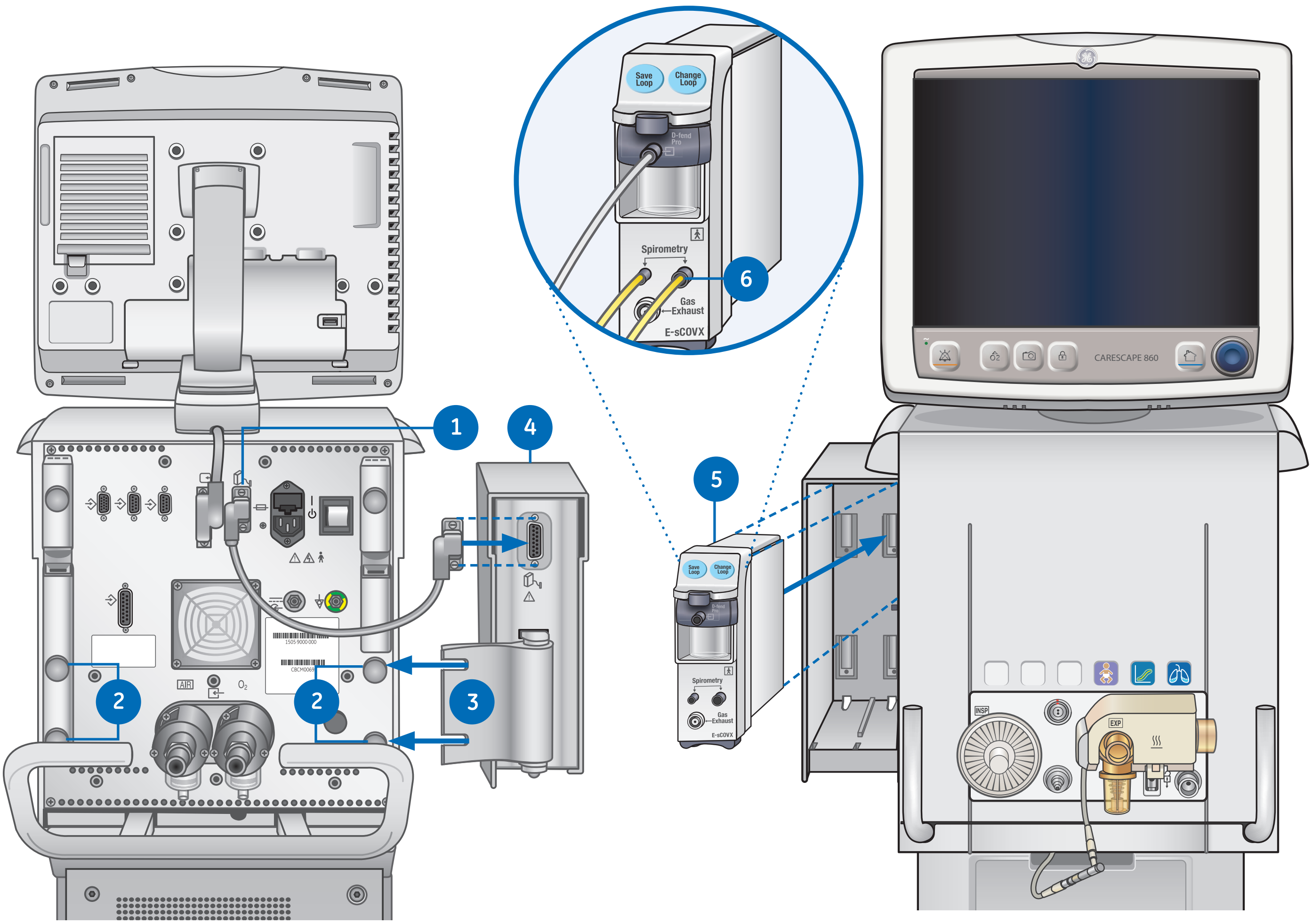
Equipment Required for Indirect Calorimetry with CARESCAPE R860



1. Module Bay with cable
2. Respiratory Module
    a. Water trap latch
    b. D-fend water trap
    c. Gas sampling line connector on the water trap
    d. Connectors for patient spirometry
    e. Gas sampling outlet
3. Disposable water trap
4. Disposable spirometry set consists of;
    a. 2 yellow plastic spirometry lines
    b. D-lite or Pedi-Lite series of sensors
    c. Sampling line (clear plastic)

Equipment Set Up

Attach the Module Bay and Module

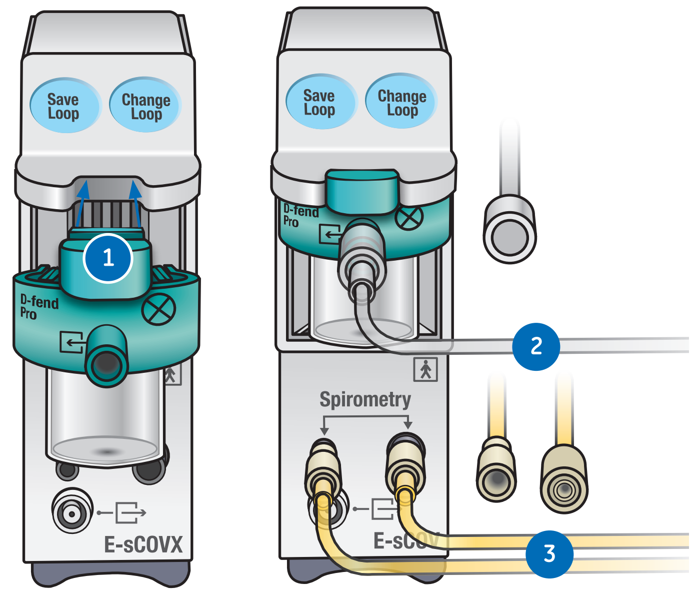


1. Connect one end of the cable to the respiratory module bay connection on the back of the ventilator, and tighten the screws.
2. To attach the module bay, loosen the thumbscrews on the desired side of the ventilator.
3. Slide the respiratory module bay behind the thumbscrews and tighten.
4. Connect the end of the cable to the respiratory module bay connection, and tighten the screws.
5. Slide the respiratory module into the upper portion of the respiratory module bay.
6. Attach the tubing to the respiratory module. (Please see next section for detailed steps on how to connect the water trap and measurement tubings).

Insert the Water Trap

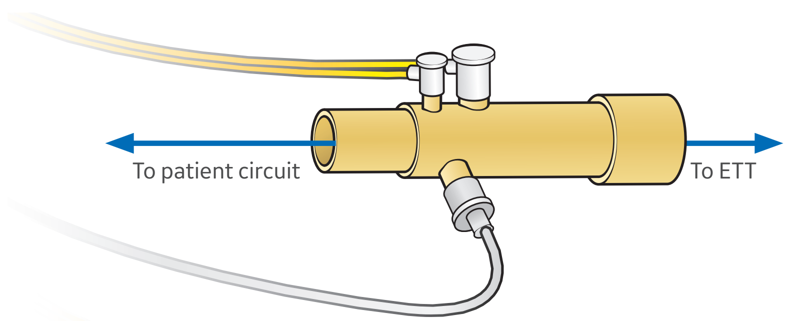
1. Hold the water trap as in the picture on the right and push it in firmly until a Click sound can be heard.
2. Connect the sampling line to the water trap.
3. Connect the 2 Spirometry lines to the 2 Spirometry ports on the module.

   Note: the difference in size and design of the connections to ensure correct assembly.
4. Ensure all 3 connections are tight to avoid leaks and errors in measurement.

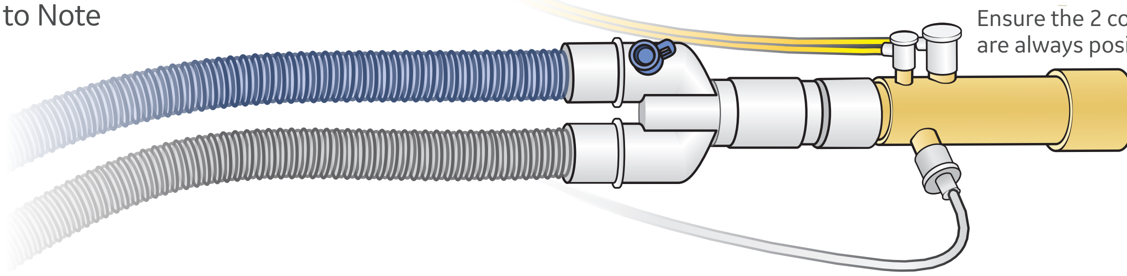


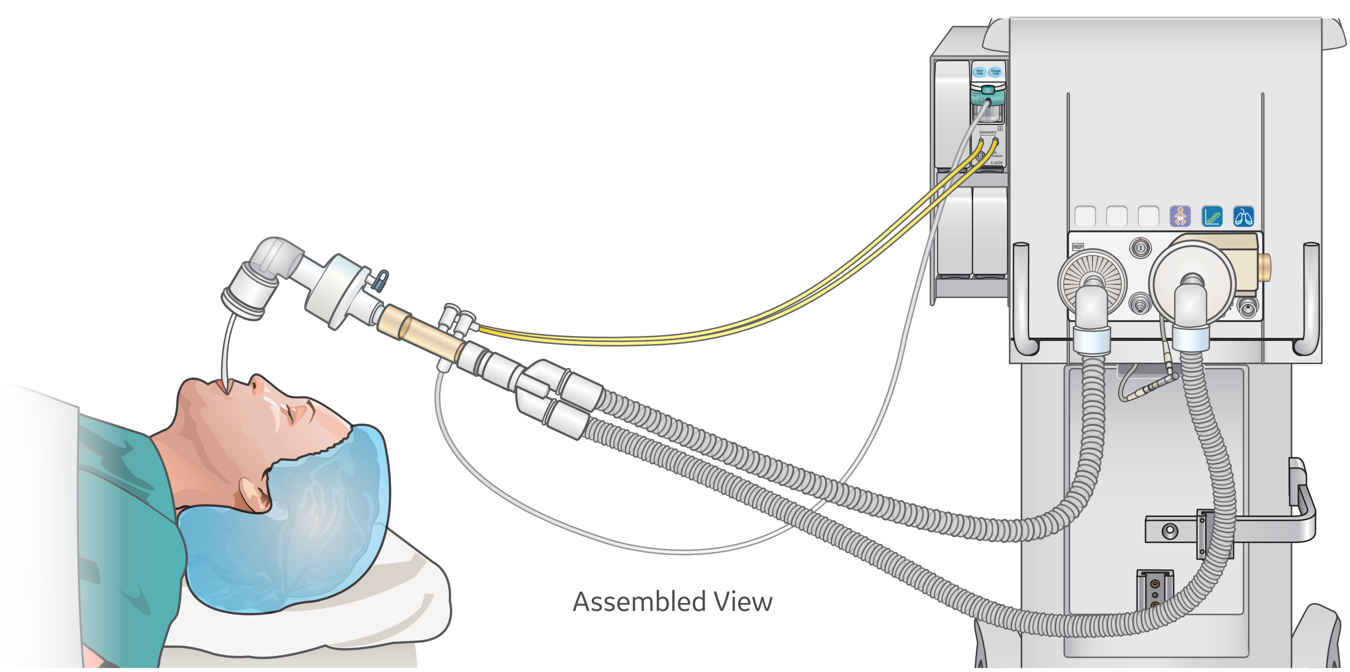
Position of D-lite Sensor

1. For optimum accuracy, allow the respiratory module to warm up for 30 min prior to performing IC readings.
2. Note that the respiratory module requires calibration every 2 months.



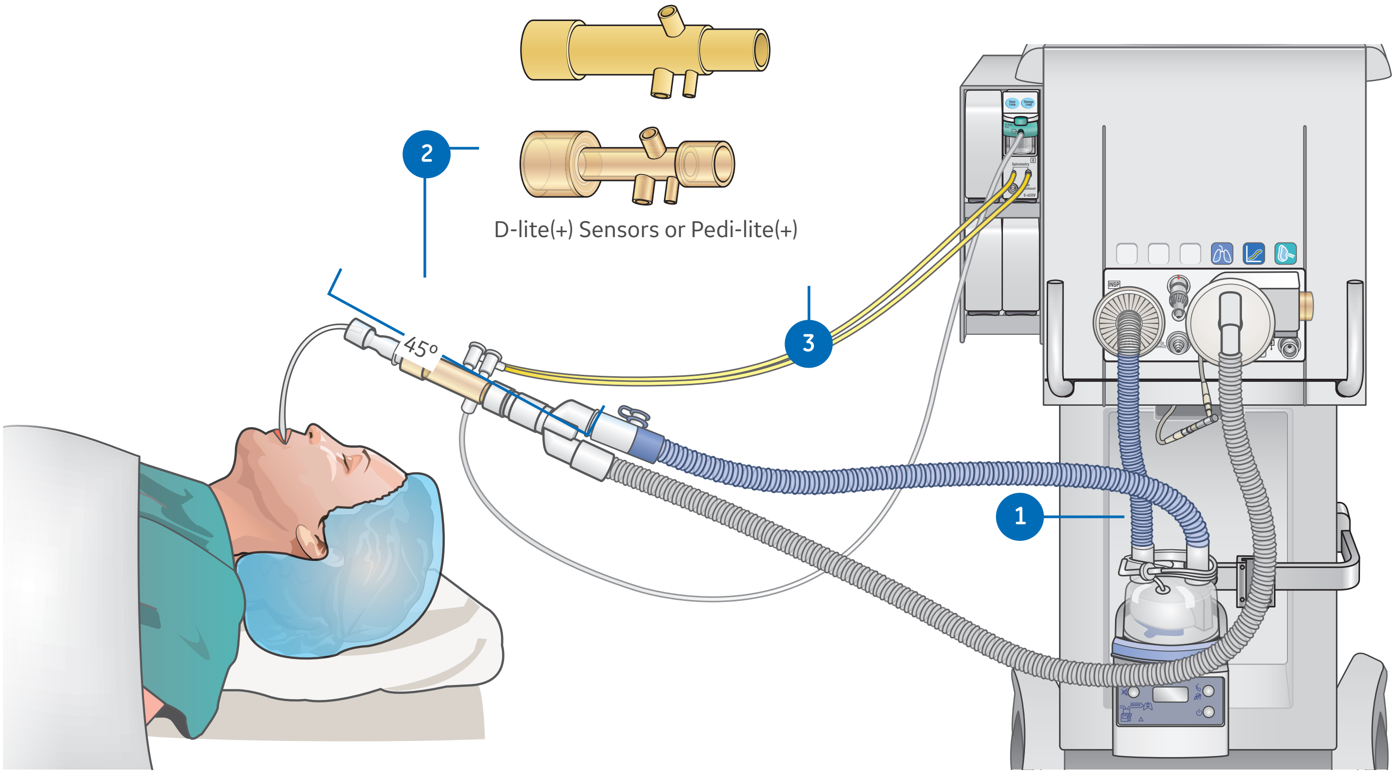
Points to Note





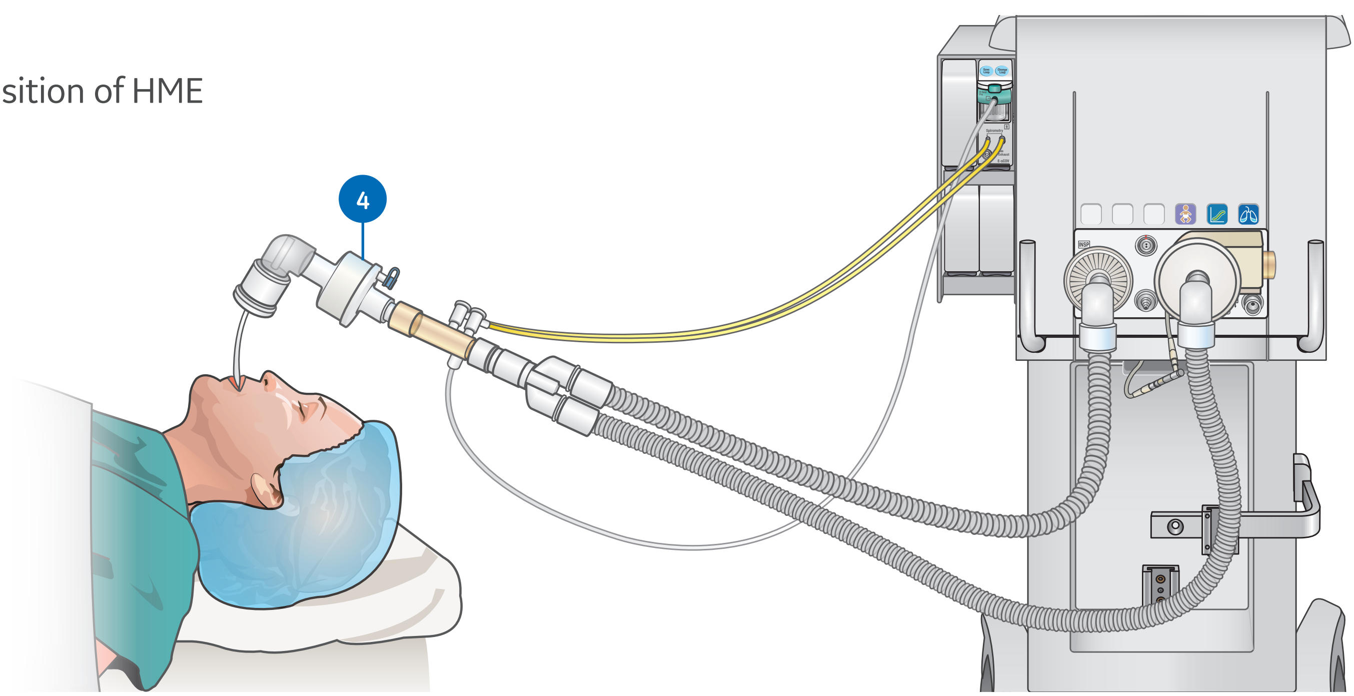
Assembled View

Managing humidity in the patient circuit



1. If an active humidifier is used, it is important that the D-lite sensor and the sampling line remain free from condensation.
2. D-lite+ and Pedi-lite+ sensors have a hydrophobic coating to repel condensation from its inner surface and minimize the possibility of entry in the sampling lines.
3. Ensure that the 2 yellow Spirometry lines and the transparent gas sampling line are positioned on the top of the sensor; and the sensor is placed at a 45 degrees tilt to avoid condensate accumulation.

Position of HME



4. If an HME (Heat and Moisture Exchanger) is used, ensure that it is placed between the D-lite sensor and the patient ETT.

Steady state

IC measurements should be taken while the patient is in steady state to ensure accuracy. The evidence-based definition of steady state is that the co-efficient of variation for VO_2 and VCO_2 are each less than 5% for 10 consecutive minutes.

There are ways to improve your IC measurements. Avoid saving measurements within:

- 8 to 12 hrs of general anesthesia
- 90 minutes of changes in ventilatory settings
- 3 to 4 hrs of intermittent hemodialysis or peritoneal dialysis
- 1 hr of any painful procedures

The CARESCAPE R860 Metabolics screen displays the VCO_2 CV and the VO_2 CV.

Using CARESCAPE R860 Clinical Decision Support Tool to find Steady State for IC Reading

Touch the Metabolics View icon to open the Metabolics View.

The 24-hour Metabolics timeline is at the top of the screen.

Select a suitable duration for analysis. Options range from 30 minutes to 6 hours. In this example, a 2-hour duration is selected.

Use the cursor to scroll through the timeline until you find a stable period.

The trended averages for VCO_2, VO_2, RQ & EE are displayed in the Metabolics trends list.

Touch the averaging cursor and use the Trim Knob to define the duration for steady state.

Finding Steady State

1. Use your finger to move the averaging cursor along the Metabolics trends to locate the latest period where both VCO_2 & VO_2 trends appear most stable and straight.
2. Check both VCO_2 CV & VO_2 CV readings to ensure that they are both within the pre-defined acceptable range of variation (based on local IC protocol), eg. 5%.
3. Confirm Avg RQ reading is within 0.67 – 1.3.

Reading EE (Energy Expenditure)

Once Steady State is confirmed, take the Avg EE reading (kcal/day).

Use the Save Metabolics button to save the data in the Trends log. Measurements will be stored for 72 hours.

When in doubt, measure more frequently or for a longer duration.

Conclusion

Proper nutrition therapy can impact the recovery of a critically ill patient[1]. Indirect Calorimetry provides objective measurements so that clinicians can provide nutrition based on data, not estimates. CARESCAPE R860 with the respiratory module allows you to take IC measurements as needed. Remember to factor in the limitations of IC and ensure the patient is in steady state for accurate results.

(1) Mcclave, Stephen A., et al. "Guidelines for the Provision and Assessment of Nutrition Support Therapy in the Adult Critically Ill Patient." Journal of Parenteral and Enteral Nutrition, vol. 40, no. 2, 14 Jan. 2016, pp. 159–211., doi:10.1177/0148607115621863.

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