

UAB Guideline for Metabolic Monitoring by Indirect Calorimetry

I. Background:

Determining energy needs for critically ill patients is challenging, and there is a significant risk of overfeeding or underfeeding in this patient population.¹ Predictive equations are inaccurate, complex, and difficult to calculate, and acute phase reactants are unreliable for directly assessing nutritional status. Indirect calorimetry (IC) is considered the gold standard to determine energy expenditure in critically ill patients, by measuring pulmonary gas exchange. The machine measures gas exchange through a mask or mouthpiece connected to a metabolic cart, which then calculates Resting Energy Expenditure (REE) and substrate utilization. This allows clinicians to adjust nutrition support to the metabolic needs of the individual patient.

II. Indications for IC Measurement:

While almost all critically ill patients on nutrition support are candidates for IC, those with highly variable and unpredictable metabolic rates due to stress and illness are most likely to benefit from metabolic monitoring. IC measurements should be considered for the following patients:

1. $\geq 20\%$ TBSA burns
2. Mechanically ventilated for ≥ 3 days and unable to liberate from vent
3. ICU length of stay ≥ 1 week
4. Critical illness myopathy
5. Patients not meeting above criteria but identified by Dietician as potentially benefitting from IC

III. Exclusion Criteria:

1. The only absolute contraindication to metabolic monitoring is if patient's condition will not allow for momentary disconnection from the ventilator.
2. However, there are a few limitations that may affect the interpretation of the test. Therefore, careful interpretation of the results should be considered in the following situations:
 - If short term disconnection of ventilator support for connection of measurement lines results in hypoxemia, bradycardia, or other adverse effects
 - In patients with unstable body temperature
 - If there is an air leak at the site of ventilation
 - If FiO₂ on the ventilator is $>70\%$ or PEEP >16
 - Patients are requiring non-invasive ventilation (BiPAP, CPAP)
 - Patients are agitated
 - Patients on CRRT and ECMO can be measured but their measurement will need to be interpreted with caution

IV. Recommendations for improving accuracy of IC:

- Supine position 30 minutes prior to the study
- Wait 60 minutes to perform IC if receiving intermittent tube feeding
- Wait at least 90 minutes post-ventilation change
- Wait 8-12 hours after general anesthesia
- Wait 3-4 hours after dialysis session
- Wait at least 2 hours after physical therapy
- Avoid administering pain medication or acute sedation within 30 minutes of the study (continuous sedation is acceptable)
- Maintain quiet and thermoneutral environment
- Cuffed trach
- Maintain ventilator settings 1-2 hours prior to metabolic evaluation

V. Procedure:

1. Ordering
 - b. A qualified provider places order for metabolic monitoring measurement in the electronic medical record (EMR)
2. Performing Metabolic Measurement
 - a. The RDN reviews the order and performs a chart review to verify indication for measurement and rule out factors that may contraindicate or prevent measurement
 - b. The RDN conducts the metabolic measurement via IC within 72 hours of order placement
3. Communication, Documentation, and Application of Results
 - a. The RDN documents results of the IC measurement within 24 hours of test completion. If not completed, rationale is documented, and reattempt date noted
 - b. The RDN interprets the results of the IC measurement and applies to determine nutrition support recommendations. The results may be compared to previously estimated energy requirements and/or compared to prior nutrition support prescriptions and intake records to interpret possibly of underfeeding or overfeeding
4. Device and Supply Management
 - a. The Nutrition Department is responsible for the device and each of the following areas:
 - *Cleaning:* The RDN or RT completing measurements is responsible for all cleaning of the IC device and parts after each use and at end of day
 - *Calibration:* *Monthly calibrations will be conducted as indicated by the IC device operator/user manual*
 - *Disposables:* The responsible department will track and order disposable parts monthly when conducting monthly calibrations
 - *Maintenance:* Annual and intermittent part replacement will be conducted by the responsible department, including changing sensors and updating firmware as needed
 - *Device Security:* *The responsible department will store the device in a locked area to ensure protected health information remains secure*

References

1. Roffe A, Schneider ML, Brown M, Ludwig D, Citty SW. The implementation of indirect calorimetry for patients with acute respiratory failure: Invited commentary on techniques and procedure. *Nutr Clin Pract.* 2025;40(3):544-554.
2. Oshima, Berger, De Waele, et al. Indirect calorimetry in nutritional therapy. A position paper by the ICALIC study group. *Clinical Nutrition.* 2017;36(3):651-662.
3. Jonckheer J, Spapen H, Malbrain MLNG, Oshima T, De Waele E. Energy expenditure and caloric targets during continuous renal replacement therapy under regional citrate anticoagulation. A viewpoint. *Clin Nutr.* 2020;39(2):353-357.
4. Pelekhaty SL, Rector RP, Wu ZJ, et al. ECMO patient energy requirements: A descriptive, retrospective cohort study. *Nutr Clin Pract.* Published online June 8, 2025.