



Critical Care Therapy and Respiratory Care Section

Category:	Clinical
Section:	Nutritional Assessment
Title:	DeltaTrac II Metabolic Monitor: Open Canopy, Closed Canopy, and Ventilator Interfacing
Policy #:	01
Revised:	04/00

1.0 DESCRIPTION

- 1.1 Definition: The Deltatrac II Metabolic Monitor is a microprocessor controlled, indirect calorimetry device that measures metabolic parameters to assess the nutritional status of patients. Specifically, the monitor measures oxygen so that an estimate of the respiratory quotient (RQ) is obtained.
- 1.2 Indications: The Deltatrac II Metabolic Monitor will be used to assess the nutritional status in both pediatric and adult patients especially as nutritional status relates to the need for adjustment of total parenteral nutrition. The cart can also be used to assess work of breathing (WOB). The cart will be available upon physician request or upon request of the approving official for the Metabolic Cart Consult Service. Metabolic assessment is especially indicated in patients whose nutritional status is poor due to gastrointestinal pathology, neurologic dysfunction, or anorexia, and in those who have hereditary metabolic derangements.
- 1.3 Contraindications
 - 1.3.1 Do not use the Deltatrac II Metabolic Monitor in the presence of flammable anesthetics.
 - 1.3.2 The monitor cannot be used with FiO_2 delivery above 0.85. (Additionally, data collected with the use of the monitor becomes much less reliable for FiO_2 's greater than 0.60.)
 - 1.3.3 The monitor cannot be used during nebulization therapy.
- 1.4 Complications: Prior to and during the study, the patient should not be manipulated or stimulated in any way. As patient care dictates, a metabolic

study may be aborted. Any activity with a patient during monitoring will affect the quality of the study.

1.5 Precautions

- 1.5.1 Do not open the monitor covers for any reason. Opening the covers has the potential for creating a significant electrical shock hazard.
- 1.5.2 The monitor should not be steam autoclaved, exposed to ethylene oxide, or immersed in any liquid.
- 1.5.3 The power cord should be properly connected to a grounded three-wire outlet and unplugged prior to cleaning.
- 1.5.4 Because the sampling gas flow is approximately 150 ml/min, adjustments of the ventilator may be required when using the monitor for ventilated pediatric patients.
- 1.5.5 When measuring a ventilated patient who is being monitored via a capnometer, the sampling gas flow to the capnometer must be collected and fed back to the Deltatrac II Metabolic Monitor. See the Operation's Manual Appendix F for specific instruction.
- 1.5.6 FiO_2 should be properly monitored with a separate oxygen analyzer when using the closed canopy system.
- 1.5.7 Canopy measurements should be attended at all times. In case of a power failure, remove the canopy from the patient immediately.
- 1.5.8 Microbial contamination of the internal sampling system requires servicing by Sensormedics personnel.
- 1.5.9 The inspiratory sampling tubing to the monitor must be connected prior to power-up, or the monitor must be manually reset.
- 1.5.10 Use only Datex sampling tubing and accessories. Do not alter the length or diameter of the tubes.
- 1.5.11 Allow at least 30 minutes warm-up time prior to calibration and monitoring.
- 1.5.12 Ammonia or acetone-based cleaners should be avoided as these may damage the monitor surface.

- 1.5.13 Good data are dependent on a leak-free system. Monitor the measurements continuously during operation and refer to the Troubleshooting Guide at the end of this procedure when necessary. When measuring a patient with an uncuffed or "leaking" endotracheal tube, it is necessary to modify the system to collect *all* expired gases. See Selby, et al. Critical Care Medicine 1195; 23:365-370 . **Be aware that chest tube leaks will also cause erroneous data.**
- 1.5.14 Ensure that the correct adapters and tubings are being used prior to initiating a study (See 3.0 Procedures).
- 1.5.15 Adjustments to the FiO₂ should not be made during a study. Optimal results are obtained only during steady state conditions.
- 1.6 Adverse Reactions and Interventions: Adjustments to nutrition therapy based on faulty metabolic data may jeopardize a patient's nutritional status. To ensure quality studies:
 - 1.6.1 The Deltatrac II Metabolic Monitor should be appropriately calibrated and maintained. Calibration procedures must be strictly followed. The monitor itself should also undergo preventative maintenance checks for RQ and flow generation. An Alcohol Burn Test should be performed a minimum of four times per year. The last date of calibration can be found on the back of the monitor.
 - 1.6.2 Any study which reveals data outside of acceptable limits should be questioned for accuracy. During measurements, efforts should be made to correct for errors in sampling of exhaled gases. It is important that the operator remain at the bedside during measurement to check for the quality of the study. For further instruction on how to obtain good data, refer to the "Troubleshooting Guide for Indirect Calorimetry".

2.0 EQUIPMENT AND MATERIALS

- 2.1 Deltatrac II Metabolic Monitor with printer
- 2.2 Mixing chamber: The obturate on the back of the monitor must be set appropriately. An FeCO₂ less than 0.5% will indicate an adjustment to the distribution. If the patient's minute ventilation is less than 4 LPM, it is best to use the pediatric mixing chamber for faster steady state conditions. Additionally, a measured FeCO₂ less than 0.5% will indicate through asterisks that the pediatric canopy is required.

2.3 Inspiratory sampling tubing with male/male luer

2.4 For Respirator Measurements

2.4.1 22F-22M steel adapter with female luer port (for adult size humidifying chamber) **OR** 15F-15M steel adapter with female luer port (for pediatric humidifying chamber)

2.4.2 22 mm mixing chamber fitting

2.4.3 22 mm corrugated tubing

2.4.4 Appropriate ventilator expiratory sampling adapter for the Servo (Siemens) 300 ventilator

2.5 For Open Canopy Measurements

2.5.1 White, dual-purpose plug

2.5.2 Appropriate size canopy and tubing,

2.6 For Closed Canopy Measurements

2.6.1 Down's flow generator

2.6.2 Pall filter

2.6.3 Noise muffler

2.6.4 22 mm corrugated tubing

2.6.5 22 mm mixing chamber fitting for left inlet

2.6.6 Appropriate size closed canopy

2.6.7 Appropriate size pressure indicator bag

2.6.8 Oxygen analyzer with T-piece

2.6.9 For Adult Studies:

2.6.9.1 35 mm canopy hose

2.6.9.2 35/35/22 mm T-piece

2.6.9.3 35 mm mixing chamber fitting for right inlet

2.6.10 For Pediatric Studies:

2.6.10.1 Additional 22 mm corrugated tubing

- 2.6.10.2 22/22/22 mm T-piece
- 2.6.10.3 35/22 mm adapter
- 2.6.10.4 22 mm mixing chamber fitting for right inlet

3.0 PROCEDURE

- 3.1 Prior to turning on the monitor and printer, ensure that the water trap is empty, the air filter is clean, and that there is a sufficient paper supply for the printer.
- 3.2 Connect the inspiratory sampling tubing to the water trap. It is necessary that the tubing be in place for the monitor to properly measure the internal reference pressures. If the tubing is missing, the monitor will display, "Open gas circuit." After connecting the tubing, simply reset the monitor by manually depressing the "reset" button.
- 3.3 Plug the monitor in and turn it on. The monitor will now go through a self-test. If any errors are detected, messages will be displayed. If messages appear, use of the monitor should be discontinued and a service representative contacted.
- 3.4 Setup:
 - 3.4.1 Press the "Setup" key, and check and adjust the following as needed:
 - 3.4.1.1 Time - current time
 - 3.4.1.2 Start Delay - should be set to three minutes for open canopy studies and at least five minutes for respirator and closed canopy studies
 - 3.4.1.3 Units - KCAL, CM, KG
 - 3.4.1.4 Mode - as appropriate
 - 3.4.1.5 Artifact Suppression - ON
 - 3.4.1.6 Averaging - ON
 - 3.4.1.7 Printer - Numeric
- 3.5 Allow the monitor to warm up for 30 minutes.
- 3.6 Perform a pressure calibration using the current barometric pressure. It is essential to perform this step *prior to* gas calibration.
- 3.7 Perform an automatic gas calibration. The calibration concentrations of oxygen and carbon dioxide are 95% and 5% respectively. The monitor will display "Calibration Completed" when a successful calibration has been performed. If the adjustment for either oxygen or carbon dioxide exceeds three percent, the monitor will prompt the user to repeat the calibration. If the adjustment requirement exceeds the maximum allowable of five percent,

repeat the calibration, or contact service personnel after several unsuccessful attempts to calibrate. In the event that the gas calibration tank is empty, the monitor will display "Bottle empty" and "N gas calibration" prompting the user to connect a new tank. Simply twist the tank on the threads at the top of the calibration sidebox.

- 3.8 Enter the patient's data for sex, height, weight, and age and press SAVE.
- 3.9 Set the flow selector wheel at the rear of the monitor according to the patient's weight:

<u>Weight</u>	<u>Flow Selector Setting</u>
< 3 kg	baby (3 LPM)
3-20 kg	child (12 LPM)
20-120 kg	adult (40 LPM)
> 120 kg	obese (80 LPM)

- 3.10 Assemble the patient circuit as shown in the following diagrams as appropriate for the patient's size:

NOTE: For respirator studies change study mode (from canopy) to "Respirator Mode". This is done by pressing the "Change Mode" button for two seconds. For respirator studies with the Siemens 300 ventilator, it is necessary to change the patient to pressure trigger of -1 to -2, so as not to dilute sample with bias flow.

NOTE: The inspiratory sampling tubing must be placed downstream from the humidifier which acts as a mixing chamber for further equilibration of the FiO_2 .

NOTE: For canopy studies, the outlet from the canopy should be positioned close to the patient's mouth, and the open canopy plastic drape should be tucked in under a pillow and around the patient to avoid leakage.

NOTE: For closed canopy studies, it is important to adjust the FiO_2 through the flow generator at least five minutes prior to the initiation of the monitoring to minimize FiO_2 fluctuation. Analyze the FiO_2 prior to placing the canopy on the patient. The pressure indicator bag should be fully inflated during inspiration and expiration. The start delay for closed canopy measurements should be a minimum of five minutes. Avoid changes to either the FiO_2 or the flow after this five minutes.

NOTE: It is important that the holes of the flow selector wheel remain open for the free flow of air. Be certain that they are not blocked by debris or the printer paper.

- 3.11 Perform the measurement for at least 20 minutes. Monitor the data continuously to ensure a good study (See 5.0 Assessment for Quality Study). Refer to the "Troubleshooting Guide" at the end of this procedure in indicated.

4.0 REPORTS (Required)

4.1 Numeric Report

- 4.1.1 This report is printed out automatically during patient testing on a minute to minute basis.

4.2 Graphic Report

- 4.2.1 This report is obtained by pressing "Display Printer" and then "Long Trend."

4.3 End Report

- 4.3.1 This report is obtained by pressing "End" and then selecting "End Report."

- 4.4 *See addendum sheet at the end of this procedure for specific instructions regarding additional paperwork required by the Metabolic Cart Consult Service and other uses of the metabolic cart.*

5.0 ASSESSMENT FOR QUALITY STUDY

- 5.1 The "End Report" summary sheet should be reviewed and assessed for the quality of the study. The standard deviations of VO_2 , VCO_2 , and RQ play an important part in assessing the quality of the study. The standard deviation for VO_2 should be less than or equal to 10%, the standard deviation for VCO_2 should be less than or equal to 6%, and the standard deviation for RQ should be less than or equal to 5%.
- 5.2 The differences in the fraction of inspired and expired oxygen ($FiO_2 - FeO_2$) should be no more than 2%.
- 5.3 FiO_2 fluctuation should be no greater than 0.5% during the numeric minute to minute data collection.

6.0 CLEAR PATIENT DATA

- 6.1 After reports have been obtained, purge patient data from the screen by pressing "End" and then selecting "Clear, New Patient."

7.0 POST PROCEDURE

7.1 Cleaning

- 7.1.1 Empty the water trap after use, if necessary.
- 7.1.2 Discard the inspiratory sampling tubing after respirator studies. The tubing may be reused for canopy studies.
- 7.1.3 All adapter and non-disposable tubings should be wiped down with alcohol, steam autoclaved, or ethylene oxide sterilized.
- 7.1.4 Wipe down the Deltatrac II Metabolic Monitor with alcohol or Dispatch, if necessary.
- 7.1.5 For further information on decontamination, refer to the Operator's Manual, pp. 7-1 to 7-3.

7.2 Reporting

- 7.2.1 Follow the instructions per "Addendum: Report Format and Instructions for Filing" (at the end of this procedure).

8.0 REFERENCES

- 8.1 Deltatrac II Operator's Manual
- 8.2 Selby et al. Indirect calorimetry in mechanically ventilated children: a new technique that overcomes the problem of endotracheal tube leak. Crit Care Med 1995; 23:365-370.
- 8.3 AARC Clinical Practice Guideline: Metabolic Measurement Using Indirect Calorimetry during Mechanical Ventilation
- 8.4 CCTRCS Procedure for Deltatrac Metabolic Monitor MBM-100 Measurements Using the Adult and Pediatric Canopies
- 8.5 CCTRCS Procedure for Deltatrac Metabolic Monitor MBM-100 Respirator Measurements

Addendum: Report Format and Instructions for Filing

The specific paperwork requirements for metabolic measurements are listed below. Please make sure all forms are filled out completely and accurately, and then contact the metabolic care consult service individual responsible for the patient studied. It is important that a Progress Note be filled out completely with an assessment of the quality of the study prior to nutritionist or pharmacist review. The metabolic care consult service representative will write a note below the one you have written.

1. IGF Protocol report requirements:
 - a. Numeric Report
 - b. Graphic Report
 - c. End Report
 - d. Progress Note

2. Metabolic Care Consult Service (including ventilator and canopy studies on 10D and other areas of the Clinical Center):
 - a. Metabolic Cart Consult Service Information Sheet
 - b. Numeric Report
 - c. Graphic Report
 - d. End Report
 - e. Progress Note

3. After the nutritionist or pharmacist has had written his/her note, the reports must be copied and filed as follows:
 - a. Two copies of the Progress Note; the original must be placed in the patient's chart either by you or the nutritionist/pharmacist. It is your responsibility to make sure this is done.
 - b. **Insulin Resistance Results:** Three complete copies of all reports and the Consult Service Information Sheet for insulin resistance protocol patients (the primary investigator's patients). One copy will go to the patient's chart and the other placed in the Section Chief's mailbox. A third copy should be placed in Dennis' mailbox. Report originals remain in the STAT Lab Metabolic Cart Manuals.
 - c. **Other Patients:** It is only necessary to make two copies of reports for other consults. One copy will go to the Section Chief and the other placed in the patient's chart.
 - d. Staple forms for CCTRCS records together and file in the appropriate manuals. Forward the other copies as appropriate.

SIGNATURE: _____
Assistant Section Chief, CCTRCS, CCMD

DATE: _____

SIGNATURE: _____
Section Chief, CCTRCS, CCMD

DATE: _____

SIGNATURE: _____
Medical Director, CCTRCS, CCMD

DATE: _____

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