The new standard for Resting Energy Expenditure measurement in research and clinical practice

“Calories, you can’t manage what you don’t measure.”

Quark RMR
Indirect Calorimetry

COSMED
The Metabolic Company
The Quark RMR is a compact bedside indirect calorimetry solution designed to allow accurate and instantaneous estimation of Resting Energy Expenditure (REE) and respiratory ratio (R), in a non-invasive way, through the measurement of oxygen consumption (VO\textsubscript{2}) and carbon dioxide production (VCO\textsubscript{2}) together with other ventilatory parameters and metabolism substrate utilization (%FAT, %PRO, %CHO). Quark RMR allows thus improved nutrition support and accurate planning of nutritional therapies.

Quark RMR is a modern device designed both for research and bedside clinical applications. By measuring REE and providing the correct energy balance in critically ill patients, hospitals may improve patient outcome, and decrease the length of hospitalization which will have a significant and immediate impact on hospital bottom line.

Scientific evidence highlights that negative energy balances are correlated with increasing number of complications, particularly infections.\(^{(2)}\)

Quark RMR accuracy and reliability have been validated against the Gold Standard methods either with spontaneously breathing subjects and with mechanically assisted patients.

**Design**

- Latest technology in gas analyzers: paramagnetic, stable and durable for the O\textsubscript{2}; rapid infrared for the CO\textsubscript{2}. Both analyzers are reliable and do not need maintenance for long periods.
- Flowmeters (disposable pneumotach and multi-use turbine) guarantee great accuracy on the different measurement modes (canopy, mask and through mechanical ventilation).
- Quick calibration procedures guarantee accurate measurements either on flow/volume (using the 3-liter calibration syringe) and gas concentration.
- Ideal for bedside applications Quark RMR compact dimensions and the optional medical graded cart configuration, make it the ideal choice for bedside applications.
- Powered by OMNIA software innovative user interface, touch screen ready, easy-to-use and self-explanatory.

**REE on spontaneously breathing subjects**

**REE by dilution with Canopy Hood**

The Quark RMR is supplied with a dilution helmet for the measurement of the expiratory flow of patients with spontaneous breathing. This method does not require a mouthpiece or facemask and is more comfortable for obese patients. Gas is sampled at the expiratory port through a sampling line, while the ventilation is measured by a turbine. The ventilation output of the helmet is easily regulated in order to maintain the CO\textsubscript{2} expired fraction (FeCO\textsubscript{2}) within a prefixed range of values.

- Bidirectional digital turbine flowmeter (reusable).
- “Bubble” canopy hood (18,7 L) with removable blanket.
- Integrated canopy blower pump inside the main unit (selectable flow rate).
- Internal emergency battery with acoustic alarms.
- Optional canopy hood kit for pediatric use (15-30 kg).

**REE breath by breath by Face Mask**

In addition to canopy, Quark RMR provides "breath-by-breath" gas exchange analysis by using multi-use silicone facial masks (available in 5 sizes: 3 adult, 2 pediatric), or, alternatively, with mouthpiece and AB filter.
REE on mechanically ventilated patients

The optional ICU module for Quark RMR allows the integration with the ventilator for the measurement of REE in patients undergoing mechanically assisted ventilation in intensive care units. The module is extremely versatile allowing two different set-ups according to specific testing requirements.

In-line Measurement within Patient’s Circuit

- Disposable low-flow range PNT flowmeter (Flow-REE) inserted at the patient’s circuit
- “Breath by breath” gas sampling through a line connected proximally to the Y-piece of the ventilator tubing
- Inspiratory and expiratory phases directly measured by the flowmeter
- All parts are single patient, no need for cleaning and disinfecting
- FiO₂ ≤ 70%
- Independent from type of ventilator in use

External Flow Measurement by Ventilator’s outlet

- Patient minute ventilation measured by a turbine flowmeter connected to the expiratory port of the ventilator
- “Breath by breath” gas sampling through a line connected proximally to the Y-piece of the ventilator tubing
- Software allows users to detect the “Bias Flow” and identifies the inspiratory and expiratory phases with the use of an algorithm based on flow and expiratory CO₂ analysis
- Easy and less invasive set-up
- Lower costs with less consumables
- Compatible with most of ventilators in the market

Data Management & Software

Quark RMR comes with the Metabolic Module of OMNIA, the new software designed by COSMED. Compatible with the entire COSMED product range, OMNIA allows the user to operate complex equipment without requiring long learning paths.

- Easy-to-use beautifully designed touch-screen (native) graphic user interface with intuitive workflow and hierarchy.
- Manage/display data and plots via Dashboards (default and user defined).
- Select and define charts, data and widgets.
- Powerful chart creation (up to 4 Y axis and one X axe) with full control on settings.
- Change blower settings directly from dedicated widget.
- Select time interval to display averaged parameters (REE, RQ, variability, etc.) both in real time and in post analysis.
- Designed to work with both standard PC and tablets.
- SQL Database allowing virtually unlimited records and data safety.
- Full Network Database Management (optional). OMNIA allows installations in complex Server/Client environments.
- Multi-users access rights management (Principal Investigator, Physician, Technician, Administrator…) with event logging.
- Compatible with Win 8 PRO (32/64), Win 7 (32/64), Win Vista (32/64). Mac OS compatibility when installed in Virtual PC OS (Parallel, VMware).

Options

- Exercise Testing Kit. With the optional CPET (Cardio Pulmonary Exercise Testing) module users can perform full exercise protocols to measure VO₂ and VCO₂ up to maximal effort.
- Ethanol burning kit. It consists of a lamp, parts and connectors to be connected to the Quark RMR. Burning ethanol generates a predictable ratio of VO₂ and VCO₂ and it can be used to verify the Quark RMR accuracy of Respiratory Quotient measurement.

Alternatively to the canopy hood, REE can also be measured on spontaneously breathing subjects using a multi-use silicone face mask (5 sizes available)

An antibacterial filter can be used when testing subjects with high risk of cross contamination
Validation articles

- More scientific studies on www.cosmed.com/bibliography

Technical Specifications

<table>
<thead>
<tr>
<th>Product</th>
<th>Description</th>
<th>REF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quark RMR</td>
<td>Indirect Calorimetry Laboratory</td>
<td>C09074-01-99</td>
</tr>
<tr>
<td>Standard packaging</td>
<td>Quark RMR unit, Canopy hood (with veil), Turbine Flowmeter (2 pcs.) w/ sampling line, antibacterial filters, OMNIA PC software, calibration syringe, HR monitor (receiver and transmitter), power supply cable, USB cable, user manual</td>
<td></td>
</tr>
</tbody>
</table>

Standard Tests

Indirect Calorimetry

Resting Energy Expenditure (REE, RMR), w/ canopy hood, face mask or mouthpieces-antibacterial filter, Respiratory Quotient (RQ), Substrates Analysis (%FAT, %PRO, %CHO)

Flowmeter

Turbine Ø-18mm (Canopy/Mask) Flow-REE (ICU) - Optional

<table>
<thead>
<tr>
<th>Type</th>
<th>Flow Range</th>
<th>Accuracy</th>
<th>Resistance</th>
<th>Visualization resolution</th>
<th>Gas Analyzers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bidirectional Digital Turbine</td>
<td>0-8 l/s</td>
<td>± 2% or 20 ml/s (flow) ± 2% or 100 ml/min (ventil.)</td>
<td>&lt;0.27 cmH₂O/l/s @ 1 l/s</td>
<td>4 ml/s</td>
<td>O₂, CO₂</td>
</tr>
<tr>
<td>Disposable</td>
<td>0-1,7 l/s</td>
<td>± 2 %</td>
<td>&lt;2,35 cmH₂O/l/s @ 11/s</td>
<td>1 ml/s</td>
<td></td>
</tr>
<tr>
<td>PNT (Lilly)</td>
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</tbody>
</table>

Type

- Paramagnetic
- NDIR

Range

- 0-100% (Standard 0-30% - ICU 0-70% - or user defined)
- 0-10%

Accuracy

- ± 0.02 %
- ± 0.02 %

Response time

100 ms

Hardware

Dimensions & weight

- Unit: 17 x 30 x 45 cm/8 Kg
- Canopy: 32 x 50 x 30 cm/0.6 Kg

Interface ports

- USB A-B, RS-232, HR-TTL, SpO2

Electrical requirements

- 100-240V ± 10% 50/60 Hz
- 12V; 1,2 Ah

Environmental conditions

- Temperature 0-50 °C (32 - 122 °F); Barometer 400-800 mmHg; Humidity 0-100%

Software

OMNIA

Available languages

- Italian, English, Spanish, French, German, Portuguese, Greek, Dutch, Turkish, Russian, Chinese (Traditional), Chinese (Simplified), Korean, Romanian, Polish, Czech, Norwegian

PC Configuration

- I3 or higher processor speed.
- Compatible with Vista (32/64), Windows 7 (32/64), Windows 8 (32/64). RAM 4GB (8GB recommended).
- 500 MB of free disk space (plus tools)

Modules

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<tr>
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<tr>
<td>ICU kit for vent Patients</td>
<td>Allowing Quark RMR measurement of REE in patients undergoing mechanically assisted ventilation.</td>
</tr>
<tr>
<td>Mixing Chamber</td>
<td>7 liters Mixing Chamber (physical)</td>
</tr>
</tbody>
</table>

Accessories & Options

<table>
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<tr>
<th>Description</th>
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<tr>
<td>Gas Calibration Kit</td>
<td>Gas cylinder required for O₂/CO₂ calibration (16% O₂, 5% CO₂, N₂ ball) and a pressure regulator</td>
</tr>
<tr>
<td>Pulse Oximetry</td>
<td>Oximeter (Xpod) requires probe Oximeter (iPod) (w/ finger probe)</td>
</tr>
<tr>
<td>Ethanol Burning Kit</td>
<td>Kit consists of a glass ampoule for the verification of respiratory quotient</td>
</tr>
<tr>
<td>Medical Cart</td>
<td>Medical-graded with isolation transformer (according to MDD directive). Designed to hold the whole equipment during bedside applications.</td>
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<td>CO3550-02-04 (120VAC)</td>
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Safety & Quality Standards

- MDD (93/42 EEC); FDA 510(k); EN 60601-1 (safety) / EN 60601-1-2 (EMC)