



ECAL in the Management of Obesity

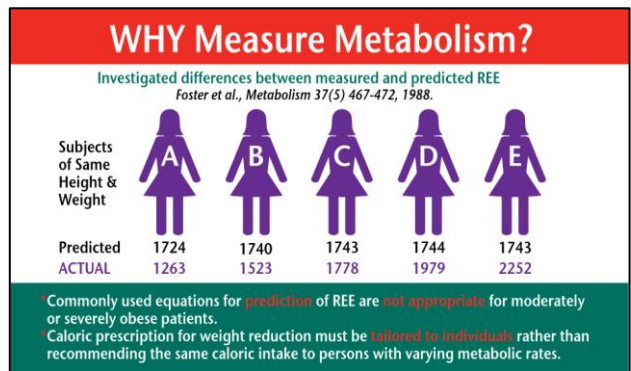
MEASURING V ESTIMATING ENERGY EXPENDITURE

Energy Testing, using Indirect Calorimetry (IC), remains the gold standard for scientifically measuring energy expenditure in the clinical setting (Karlsson, 2008; Haugen et al, 2007).

“An accurate assessment of energy expenditure is necessary to complete proper nutrition assessments and plan interventions in acute care settings. Energy imbalance can result in weight loss or weight gain. The high error rate of most predictive equations means that in cases where it is feasible, indirect calorimetry should be utilized because it is the most accurate method of determining RMR”. (PEN 2012)

IC has been successfully used in both the research and clinical setting to assess energy expenditure and set energy goals to positively influence weight loss (Mueller, 2010; Cesar, 2008; McDoniel, 2008; Rodrigues, 2008; Boschi, 2007; Pereira, 2004).

Currently, health practitioners use predictive equations, such as the Harris-Benedict (Harris and Benedict, 1919) or Mifflin formula to estimate energy requirements, despite them being of little value due to significant inaccuracies (Owen et al, 1987; Owen et al, 1986; Daly et al, 1985). This is because they do not factor in the actual caloric requirements of the various subjects who can be of the same sex, age, weight and height, but have different body compositions (Foster et al, 1988).



ECAL INDIRECT CALORIMETRY FOR PRACTITIONERS

ECAL is a new portable IC designed specifically for primary practitioners. A key component of ECAL is dedicated software that interprets the data, and provides the practitioner with subject specific questions and intuitive reports based on the best available evidence. This provides the practitioner with the confidence to individualise nutrition and activity programmes based on real time metabolic and nutritional need. ECAL has been validated against standard reference technologies, such as DeltaTrac and the G.E.M. Nutrition Device. *Journal of Nutrition Science 2014 doi:10.1017/jns.2014.58*



ECAL can provide more than just accurate determination of RMR and researchers are now using IC as a means of evaluating fuel substrate use and mitochondrial efficiency. More recently researchers have looked at the benefits of assessing which fuels are being utilised at rest as a means of further individualising nutrition programmes, with a view to ensuring that the majority of energy is produced from fat stores, as this is ultimately the goal of both short term and sustained weight loss.

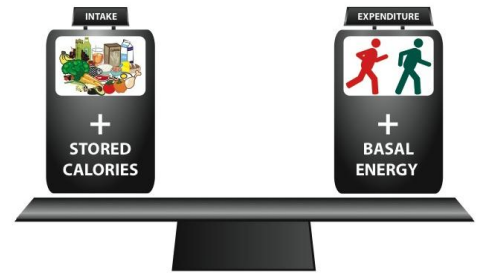
Indirect Calorimetry - ECAL	Predictive Equations
ECAL will accurately measure energy production at rest (RMR) ECAL Accuracy \pm 1.2%	Predictive equations may over or underestimate by between 21% - 40%
ECAL can accurately assess substrate utilisation, i.e. the fuels being used at rest to generate energy (fat/glucose)	Not Applicable
ECAL can accurately assess mitochondrial function, i.e. the efficiency of the mitochondria to generate energy from supplied fuels	Not applicable



ENERGY BALANCE, RQ AND FAT LOSS

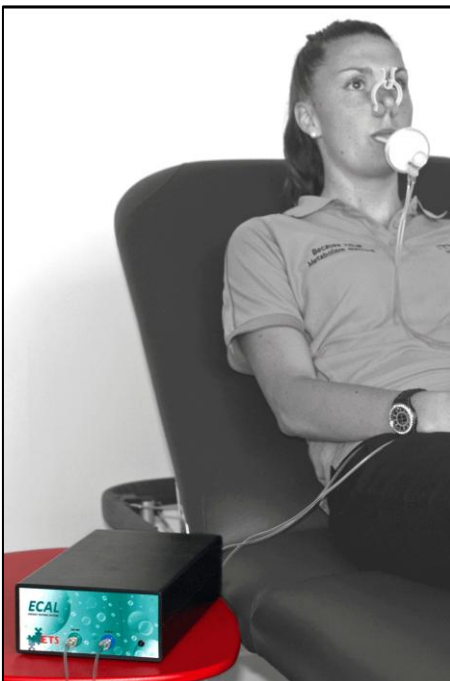
Human energy comes from chemical energy released from nutrients through the oxidation of food substrates. The rate of energy expenditure is a person's metabolic rate or metabolism. Traditionally it has been assumed that to maintain optimal body weight and energy levels, there must be a balance between foods consumed (calories in-CI) and energy demand (calories out-CO). This concept of energy balance (CICO) stems from the notion that to achieve weight loss a simple reduction in calories is required. The popular notion that a weekly reduction of 1lb of body weight requires a weekly reduction of 3500kcal, has in fact no scientific basis and is not supported by the literature (Stunkard 1959, Franz 2007). This has led researchers to consider that the macronutrient composition of the diet may be more important than the total calorie load (Jequier 2002, Feinman and Fine 2004, Bray 2012).

This idea is further developed by those researchers supporting the alternative nutrition hypothesis (CI - [Hormone/Enzyme] - CO).



In addition to RMR, ECAL can measure which fuels are being used at rest to generate energy. ECAL reports the Respiratory Quotient (RQ) sometimes called Respiratory Exchange Ratio (RER). This is the ratio of fuels (fat/glucose) used to generate energy at rest.

There is a need for technological advances that will make the assessment of REE accurate, portable, and inexpensive.
Prof. GD Foster 2001



To achieve sustained weight loss, fat must be the primary fuel both at rest and light to moderate exercise, however it has been frequently observed that many obese subjects have high resting RQ scores, indicating reduced fat utilisation. This is particularly evident in subjects who regain weight after initial success (Hainer 2000, Ellis 2010). Individuals with relatively higher resting RQ are known to be at risk for weight gain (Zurlo, 1990). This paper showed that individuals in the highest decile of RQ have a 2.5-fold increased risk of at least a 5 kg weight gain compared to those in the lowest decile.

High RQ indicates increased glucose use at rest and it has therefore been suggested that high RQ is correlated to increased circulating insulin levels (Nagy 1996, Blaak 2006). This would support other observations of reduced fat oxidation in subjects with early insulin resistance, reduced insulin sensitivity, and, some other metabolic disorders (Kelley 1999, Godecke 2000, Mensenke 2005). AUSDIAB reports that 25% of Australians are insulin resistant, with American researchers suggesting this number rises to 1 in 2 in the Obese (Reaven 2004, Reaven 2011), suggesting RQ may be an indicator of an

approaching metabolic disorder.

Therefore the ability to monitor RQ in obese subjects may be as important as RMR in achieving long term weight loss, particularly where very low calorie diets (VLCD) or low fat high carbohydrate (LFHC) diets are employed.

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ECAL Metabolic Monitor

Designed for Practitioners by Practitioners



ECAL is a small Indirect Calorimeter that has been built specifically to perform resting energy assessments using Indirect Calorimetry technology, the Gold Standard for measuring metabolic rate. It is designed and built in Australia, to International CE standards of manufacturing.

ECAL has the following advantages compared to conventional calorimeters:

(1) Affordable and Portable

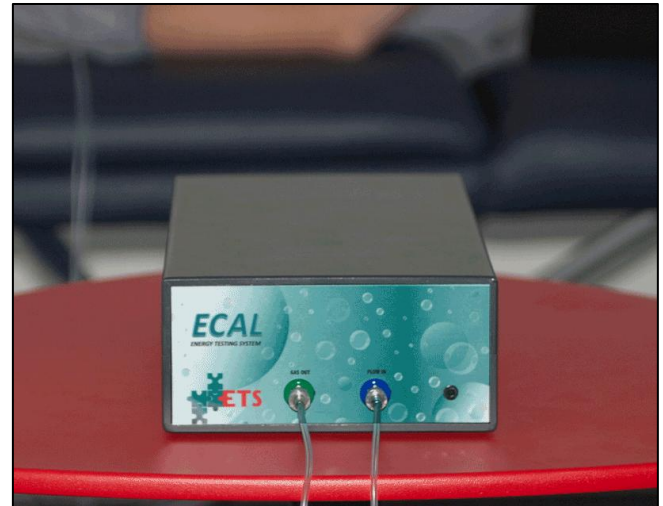
ECAL is the most affordable Indirect Calorimetry system on the market incorporating O₂ and CO₂ sensors. It also has a small footprint of 25cm by 30cm by 8cm.

(2) Multifunctional

Can be used in a variety of settings, including General Medicine, Metabolic Assessment, Nutritional Prescription, Sports Medicine, Intensive Care, Exercise Rehabilitation and Respiratory Medicine.

(3) Ease of use

Requires minimal training to operate effectively due to its auto-calibration feature. Intelligent software designed by physiologists for health practitioners to help overcome the complexity of metabolic testing and interpretation. The software analyses raw metabolic data (inspired O₂, expired CO₂, flow rate) and provides written and visual interpretation of the client data in an intelligent, easy to understand format in the form of two reports, one for the client and the other for the health practitioner.



ECAL Software can report...

Actual calorie expenditure at rest

Resting Metabolic Rate or Resting Energy Expenditure. This shows normal daily resting energy requirements and can indicate normal, high, or low metabolic rate.

Substrate Utilisation

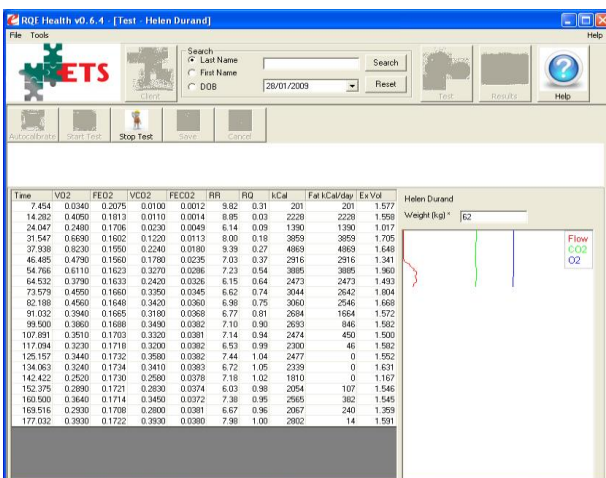
The type of fuels (carbohydrates, fats or proteins) used to generate energy. The ratio of calories burned between the various types of fuels to generate energy sheds light on the effect of the various dietary interventions on a person's metabolism. For instance, it is a measure of Fat Burning (critical for weight loss applications).

Metabolic Disease Assessment

Whether there is potential for an energy related metabolic disease, e.g. inability to metabolise carbohydrate or fat.

Mitochondrial efficiency

Pre test and post test questionnaires together with the test results, review mitochondrial performance and monitor any intervention strategies.



ECAL provides accurate Breath by Breath measurements during the test process

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