CPD Tutorial Series

Mini-Tutorials in Nutrition Support

CN Magazine has joined forces with Stephen Taylor, Research Dietitian, Frenchay Hospital, Bristol – author of the book Nutrition Support and developer of FeedCalc – to bring you a special series of CNPD mini-tutorials around Nutrition Support.

The tutorials cover a range of topics around nutrition support in general with a particular focus on nutrition requirements. To facilitate the tutorials you will need to visit www.nutrition2me.com for full details, support information and links to the following free downloads:

- **Nutrition Support eBook sample:** Nutrition Support is 2 books in 1 volume: 'Energy and nitrogen requirements in disease states' and 'Facts, patterns and principles'.
- **FeedCalc Trainer:** Enables the individualised care proposed within 'Nutrition Support' to be attained within health service pressure. 'FeedCalc' automates estimation of nutritional requirements and feed prescription, checks for adequacy or toxicity and makes a patient record (clinical version only) for re-use.

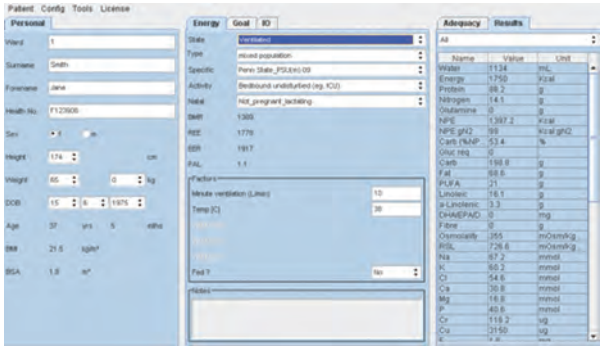
The Mini-Tutorial series provides you with the opportunity to increase your knowledge in the area of nutrition support, assisting continuing professional development, along with providing a taster of both the Nutrition Support book and the FeedCalc software.
Each tutorial has two parts:

- Clinical scenario: A clinical state is introduced followed by technical questions and calculations facilitated through FeedCalc.
- Practice & prescribing: You simulate a prescribing scenario through FeedCalc to determine optimal prescription, adequacy and possible toxicity.

The third 'Mini-tutorial' covers Resting Energy Expenditure (REE), Basal Metabolic Rate (BMR) and Stress Factors, see the next page to read the background information to this tutorial.

Nutrition Support eBook sample

FeedCalc Trainer



'Nutrition Support' + 'FeedCalc Trainer' won the 2013 BDA Education (Elizabeth Washington) Award. 'Mini-Tutorials' are samples (± modification) from 'Nutrition Support'. The Mini-Tutorials are serialised in and downloadable from www.nutrition2me.com with full links to all required downloads. Full text/Tutorials are available from: www.nutritionsupport.info.

Tutorial 3

Resting Energy Expenditure (REE), Basal Metabolic Rate (BMR) and Stress Factors

REE is most commonly estimated from addition of a stress factor to estimated BMR. Stress factors are obtained by measuring REE in patients, then determining this as a percentage of a standard BMR equation. For example, if REE was 1320 kcal/d and a standard BMR equation estimated BMR as 1200 kcal/d for the same patient, then REE is 110% of BMR, that is, a 10% stress factor.

BMR

BMR is the energy required to maintain cell membrane ion pumps and molecular metabolism (mainly brain, liver and kidney) and involuntary muscle contraction (10-20%) (mainly heart and ventilation).[1] BMR per kg body weight declines rapidly from neonate to adult as the proportion of high metabolic rate organ tissue falls (adult %BMR: Brain: 19, heart 10, kidney: 7, liver: 29, muscle 18).[2] A slower non-linear decline occurs in adults dependent on changes in fat-free mass (FFM) and its composition.[3] The FFM decline is one to two per cent per decade in men who maintain constant weight[4] but FFM loss accelerates in women post-menopause.[5] Furthermore, there is reduction in REE/kg FFM related to an age-related decline in exercise and energy intake but this does not occur when exercise and/or energy intake are maintained.[6]

The most commonly used equations to predict BMR are: Harris-Benedict (HB),[7] Schofield (S, SWH when using weight and height)[8, 9] and WHO.[10] HB was developed from a small dataset containing no children, is commonly mis-quoted and its use with adjusted rather than actual body weight has lead to serious error.[11, 12] WHO and S formulae were developed from large datasets but can significantly overestimate BMR in all populations, particularly in Asian people or the overweight;[13, 14] new BMR equations were developed from larger databases with a wider ethnic mix.[13] Use of FFM has been suggested to improve estimation of BMR[15] but necessitates body composition analysis, itself prone to error. Indeed, while confirming that WHO equations over- and under-estimated low and high REE, respectively, and that HB equations overestimated REE in the underweight, new, BMI-specific equations based on weight, age and sex were found to be as accurate as FFM- and FM-based equations.[16]

Clinically, the USA and UK have recently converted to using Mifflin[17] and Henry[13] equations, respectively, for estimating REE. Unfortunately, most stress factors used are based on HB equations. Using a HB-derived stress factor with a different BMR equation results in some error. Errors are largest (>10-20%) at the extremes of age (>70y), height (<10th centile) and weight (BMI < 18), that is, the patients least likely to cope with substrate overload or underfeeding. To reduce error, use the same BMR equation from which a stress factor was derived (see **CNPD Question 2 onwards**).

Now visit **www.nutrition2me.com**, and access the 'Mini-Tutorials in Nutrition Support' under the CNPD section – here you will find all the information you need and will be able to complete the CNPD questions linked to this issue's 'Mini-Tutorial' Resting Energy Expenditure (REE), Basal Metabolic Rate (BMR) and Stress Factors.

References: **1.** Jequier E, Acheson K, Schutz Y (1987). Assessment of energy expenditure and fuel utilization in man. Annual Review of Nutrition; 7: 187. **2.** Elia M (2000). Hunger disease. Clinical Nutrition; 19: 379-86. Elia M (2000). Fuels of the tissues. In: Human Nutrition and Dietetics, p37-59. 10th edition. Garrow J, James W, Ralph A (Eds). Churchill-Livingston. Edinburgh. **3.** Piers L, et al (1998). Is there evidence for an age-related reduction in metabolic rate? Journal of Applied Physiology. 1998; 85: 2196-2204. **4.** Keys A, Taylor H, Grande F (1973). Basal metabolism and age of adult man. Metabolism; 22: 579-87. **5.** Svendsen O, Hassager C, Christiansen C (1995). Age- and menopause-associated variations in body composition and fat distribution in healthy women as measured by duel-energy x-ray absorptiometry. Metabolism.; 44: 369-73. **6.** van Pelt R, et al (2001). Age-related decline in rmr in physically active men in relation to exercise volume and energy intake. American Journal of Physiology, Endocrionology and Metabolism.; 281: 633-9. **7.** Harris JA, Benedict TG (1919). Biometric studies of basal metabolism in man. Publication number 279. Carnegie Institute of Washington, Washington DC. **8.** Schofield WN (1985). Predicting basal metabolic rate, new standards and review of previous work. Human Nutrition: Clinical Nutrition; 39C, supplement 1: 5-41. **9.** Department of Health (1991). Dietary reference values for food energy and nutrients for the United Kingdom. In: Report of the panel on Dietary Reference Values of the Committee on Medical Aspects of Food Policy. London: HMSO. **10.** WHO (1985). Energy and protein requirements. Report of the joint FAO/ WHO/ UNU Expert Consultation. Technical report series 724. World Health Organization, Geneva. **11.** Van Way C (1992). Variability of the Harris-Benedict equation in recently published textbooks. Journal of Parenteral and Enteral Nutrition; 16: 566-8. **12.** Frankenfield D, et al (2003). Validation of several established equations for resting metabolic rate in obese and nonobese people. Journal of American Dietetic Association; 103: 1152-9. **13.** Henry CJK (2005). Basal metabolic rate studies in humans: measurement and development of new equations. Public Health Nutrition.; 8: 1133–1152. **14.** Siervo M, Boschi V, Falconi C (2003). Which REE prediction equation should we use in normal-weight, overweight and obese women? Clinical Nutrition.; 22: 193-204. **15.** Barak N, et al (2003). Use of bioelectrical impedance analysis to predict energy expenditure of hospitalized patients receiving nutrition support. Journal of Parenteral and Enteral Nutrition; 27: 43-6. **16.** Muller M, et al (2004) J. World Health Organization equations have shortcomings for predicting resting energy expenditure in persons from a modern, affluent population: generation of a new reference standard from a retrospective analysis of a German database of resting energy expenditure. American Journal of Clinical Nutrition; 80: 1379-90. **17.** Mifflin M, et al (1990). A new predictive equation for resting energy expenditure in healthy individuals. The American Journal of Clinical Nutrition; 51: 241-7.