

## Estimating energy, protein & fluid requirements for adult clinical conditions

Wherever possible, energy requirements of individuals should be measured using indirect calorimetry or other objective measures. Where measuring energy expenditure is not possible, prediction equations can be used, however, there is a lack of strong and consistent evidence supporting standardised predictive equations. As a result, when estimating requirements for protein and energy, the following should be taken into account.

Starting point only	Predictive equations are not considered accurate for individuals in the clinical setting. Although these provide a useful starting point, the emphasis should be on reviewing and reassessment, considering changes to treatment goals, clinical conditions, biochemical and anthropometric parameters, and patient activity levels.
Ease of use	Consider using predictive methods that are easy to apply, do not need calculators, and do not require multiple clinical measurements. At the bedside, these are just as likely to provide adequate estimates of requirements as those that take more time and effort.
Using a data range	Single figure estimates imply accuracy. This can be misleading and result in poor follow-up.
Rounding data / units of Measure	Consider rounding protein requirements in units of 5, and round kilojoules to the nearest 100kJ. Simple maths avoids the need for calculators.
Clinical measurements	Consider the following: Is the patient's weight / height an estimate or an accurate measure? Are they fluid overloaded or do they have ascites? What is your assessment of body composition? Should an adjusted body weight be used?
Consider the evidence base	Are the original data sets relevant to the current patient population? Is the methodology applicable at an individual patient level?
Be flexible	Remember that other professionals may use different data ranges and that these also may be justifiable. Remember: ensuring review and reassessment is the key to patient focused care.

### Weight to be used for calculations

Within Healthy Weight Range (BMI 18.5 - 25kg/m <sup>2</sup> )*	Use actual weight
Underweight	Use actual weight
Overweight/Obese <sup>^</sup>	Consider use of adjusted body weight IBW + [(actual weight – IBW) x 25%] <b>IBW = weight at BMI 25</b>

\* BMI reference ranges can vary according to clinical condition, for example in renal disease and elderly people. See *NEMO Using Body Mass Index* guide for further information.

<sup>^</sup> The use of an adjusted body weight is highly debated in the literature. Consider your patient's body composition when adjusting their body weight. For example, no adjustment may be required for an overweight individual with high lean body mass or an adjustment factor of 50% may be used where it is suspected that the patient has a higher muscle mass contributing to higher BMI. There is no data available to recommend level of adjustment of body weight for BMI >60.

## Estimating energy, protein & fluid requirements

The following 'ratio method' equations for estimating energy, protein and fluid requirements have been collated from the available evidence-based guidelines and literature (see reference list). Please note that **many of these equations are based on 'expert opinion' or have limited supporting evidence**, in the available guidelines. The Queensland Health NEMO Nutrition Support Group recommends these equations **be used only as a starting point** for establishing nutrition support, and that clinicians have a thorough understanding of their context within respective evidenced-based guidelines or literature. Regular ongoing monitoring and assessment to determine individual patient requirements is essential.

Patient category	Energy		Protein g/kg
	kJ/kg	kcal/kg	
<b>Not hypermetabolic</b> <i>Includes:</i> CVA <sup>1</sup> , ulcerative colitis/Crohn's <sup>2</sup> HIV/AIDS <sup>3</sup> Acute elderly patients <sup>4-6</sup> Adults <sup>7</sup> (not severely ill or injured, nor at risk of refeeding syndrome)	100-125	25-30	0.8-1
	110-125	26-30	0.8-1
	100-125	25-30	1-1.5
	100-145	25-35	0.8-1.5
<b>Moderately hypermetabolic</b> <i>Includes:</i> post-operative (~14days) <sup>8,9</sup> , repletion, infection, temperature >38°, head injury <sup>10</sup> , multi-trauma <sup>11</sup> , BMT <sup>12</sup> , peritonitis, burns (10-20% FTB/DPT), exacerbation COPD <sup>13,14</sup> XRT or chemoXRT <sup>8,15</sup> Pancreatitis <sup>16,17</sup> Pressure Injury <sup>18,19</sup> Cancer cachexia <sup>20</sup> (note: EPA 1.4-2g/day may be warranted)	125-145	30-35	1.2-1.5
	≥125	30	≥1.2
	105-145	25-35	1-1.5
	125-145	30-35	1.25-1.5
	≥120	≥30	≥1.4
<b>Hypermetabolic</b> <i>Includes:</i> burns (>20% FTB/DPT) <sup>21</sup> Liver disease <sup>22</sup> (cirrhosis, alcoholic steatohepatitis, post-transplantation) Hepatitis C <sup>23</sup> Cystic Fibrosis <sup>24</sup> 120-150% usual requirements for age/gender	145-160	35-40	1.5-2.0
	145-160	35-40	1.2-1.5
	105-160	25-40	
<b>Anorexia nervosa / Refeeding risk</b> <sup>7, 25,26</sup> <i>This is a starting point only. Increase gradually<sup>27</sup>, monitoring relevant parameters for refeeding syndrome and overfeeding.</i>	≤4000kJ or 80kJ/kg		
<b>Renal (IBW = dry ABW if overweight)</b> <sup>28-30</sup> Stage 3 CRF: GFR>30; Nephrotic (>3g urinary protein/day) Stage 4 CRF: GFR<30 Haemo / IPD, CVVHD CAPD (need to account for bag glucose in kJ)	100-125	25-30	0.75-1
	125-146	30-35	0.75-1
	125-146	30-35	>1.1
	125-146	30-35	>1.2
<b>Critically ill</b> <sup>31,32</sup> <i>During the acute and initial 'ebb' phase of critical illness, high energy intake may be associated with a less favourable outcome. This is a starting goal only and should be titrated up to meet higher requirements during the anabolic 'flow' phase.</i>	105-125	25-30	1.3-1.5
<b>Adjusted weight</b>	<b>Fluid per day</b>	<b>OR</b>	
40 – 60kg	1.5-2L	30-35mL/kg <sup>7</sup> with allowances for extra losses via drains etc.	
60 – 80kg	2-2.5L	<b>Note:</b> some caution should be used with elderly patients who may have reduced cardiac/renal function (20-25mL/kg <sup>33</sup> suggested starting point for IV fluids) <b>AI</b> 2.1-2.6L of fluid per day for adults <sup>34</sup>	
>80kg	2.5 -3L		

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## Further Information

There is no evidence to support the use of 'non-protein calories' when using predictive methods to estimate energy requirements.

A number of equations have been developed to estimate basal or resting requirements in healthy subjects. Although not well evidenced, these are often combined with adjustment factors for the thermogenic effect of food, activity levels, and injury / disease state to estimate patient requirements. Most authors suggest multiplying BMR by activity factor, and then multiplying by injury factor, rather than adding the two together and then multiplying.

Advantages and disadvantages of key predictive equations are listed below. The NEMO Nutrition Support Group advocates the use of the Ratio Method for ease of initial application with a focus towards reviewing and reassessment.

Equation	Comment	Pros	Cons
<b>Ratio Method</b>	Provides an estimate of total energy requirements	<ul style="list-style-type: none"> <li>• Ease of use</li> <li>• No height required</li> <li>• Allows for different disease states</li> </ul>	<ul style="list-style-type: none"> <li>• Does not take into account age or gender differences</li> <li>• Not evidence based for individual patient use</li> <li>• Does not take into account body composition although can be combined with adjusted body weight formula</li> </ul>
<b>Mifflin-St Jeor equation</b>	<p>Provides an estimate of resting energy expenditure</p> <p>Requires use of injury factors where relevant</p> <p>Endorsed by the American Dietetic Association</p>	<ul style="list-style-type: none"> <li>• Very simple and easy to remember</li> <li>• More applicable to populations with increased obesity compared to Harris Benedict Equation, Schofield</li> </ul>	<ul style="list-style-type: none"> <li>• Requires a calculator</li> <li>• For patient use, requires incorporation of non evidence based injury factors</li> <li>• Original equation not designed to be used with injury factors</li> <li>• Individual variance in BMRs may be as high as 10%. Use of activity and injury factors may accentuate this error</li> <li>• Requires height</li> </ul>
<b>Ireton-Jones equation</b>	<p>Provides an estimate of total energy requirements</p> <p>Developed for use in</p>	<ul style="list-style-type: none"> <li>• More relevant to current hospital patient population as recent data accounts for changes in medical management as well as shifts in</li> </ul>	<ul style="list-style-type: none"> <li>• Requires a calculator</li> <li>• May tend to underestimate requirements for some patients</li> <li>• Assumes patients are only critically ill whilst</li> </ul>

	hospital patients	<p>population anthropometry/activity</p> <ul style="list-style-type: none"> <li>• Does not require height</li> <li>• Does not require injury or activity factors</li> <li>• Less likely to overestimate requirements for obese patients</li> <li>• Includes consideration for trauma, burns</li> </ul>	<p>ventilated</p> <ul style="list-style-type: none"> <li>• Does not allow for differences in burns / trauma severity</li> <li>• Does not allow for anabolic phase during convalescence</li> <li>• Assumes all obese patients have same body size and body weight</li> </ul>
<b>Schofield equations</b>	<p>Provides estimates of BMR.</p> <p>Requires use of activity factors and injury factors where relevant</p>	<ul style="list-style-type: none"> <li>• BMR equation based on large data pool</li> <li>• Does not require height</li> <li>• Can allow for different disease states if injury factors applied</li> </ul>	<ul style="list-style-type: none"> <li>• Requires a calculator</li> <li>• Not evidence based for individual patient use</li> <li>• For patient use, requires incorporation of non evidence based injury factors</li> <li>• Original equation not designed to be used with injury factors</li> <li>• Individual variance in BMRs may be as high as 10%. Use of activity and injury factors may accentuate this error</li> <li>• Potential bias in data pool including many more men than women, high proportion fit young males, and differences in ambient temperature</li> </ul>
<b>Harris Benedict equation</b>	<p>Provides an estimate of BMR</p> <p>Requires use of activity factors and injury factors where relevant</p>	<ul style="list-style-type: none"> <li>• Most commonly used historically and internationally</li> </ul>	<ul style="list-style-type: none"> <li>• Requires a calculator</li> <li>• Not evidence based for individual patient use</li> <li>• For patient use, requires incorporation of non evidence based injury factors</li> <li>• Original equation not designed to be used with injury factors</li> <li>• Individual variance in BMRs may be as high as 10%. Use of activity and injury factors may accentuate this error</li> <li>• Has been noted to overestimate requirements when compared with indirect calorimetry</li> <li>• Requires height</li> <li>• 1919 data set predominantly young and lean and not considered relevant to Australian hospital patients</li> </ul>
<b>Toronto equation</b>	Burns specific equation	<ul style="list-style-type: none"> <li>• Integrates many clinical affecting requirements</li> </ul>	<ul style="list-style-type: none"> <li>• Requires a calculator</li> <li>• Difficult to remember</li> </ul>

	<p>Provides an estimate of total energy requirements</p> <p>Being increasingly recommended for use in burns units</p>	<ul style="list-style-type: none"> <li>• Takes degree of burns into account</li> </ul>	<ul style="list-style-type: none"> <li>• Time-consuming</li> <li>• Includes Harris Benedict equation</li> <li>• Requires accurate information on dietary intake</li> <li>• Formula based on studies using small cohorts</li> </ul>
<b>Penn State University Equation</b>	<p>Uses the Mifflin-St Jeor equation with the addition of ventilation and maximum temperature.</p> <p>Recommended by ASPEN for use in Obese critically ill and hospitalised patients.</p>	<ul style="list-style-type: none"> <li>• Good prediction accuracy in critically ill, obese patients</li> </ul>	<ul style="list-style-type: none"> <li>• Requires a calculator</li> <li>• Requires height</li> <li>• Minute ventilation data may not be routinely available</li> </ul>
<b>Oxford (Henry) equation</b>	<p>Provides an estimate of BMR</p> <p>Recommended by British Dietetic Association Parenteral and Enteral Nutrition Group</p>	<ul style="list-style-type: none"> <li>• May be less likely to overestimate BMR than Schofield equation</li> <li>• Data used in the development of this equation more representative of modern populations than Schofield equation</li> </ul>	<ul style="list-style-type: none"> <li>• Requires a calculator</li> <li>• Requires height</li> <li>• May need further breakdown of elderly population groups</li> <li>• Requires use of activity factors which may multiply any errors</li> </ul>

### Further reading:

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