

## Prediction Equations to Determine Caloric Requirements in Critically Ill Patients

It's tough to make predictions, especially about the future.

—Yogi Berra

The ability to predict resting energy expenditure in a given individual during critical illness is very difficult. The unreliability of prediction equations to determine caloric requirements in critically ill patients is well established.<sup>1-17</sup> The stress response to a specific insult is not identical across individuals, which further impairs the accuracy of prediction equations. Even the variables used in the prediction equations may be difficult to determine. Obesity, excess body water, and critical illness cloud the ability to choose a body weight variable. Population differences of ethnicity, age, and height limit the suitability of prediction equations to accurately determine resting energy expenditure in certain individuals.

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Two papers in this issue of *RESPIRATORY CARE* address the determination of caloric requirements in critically ill patients. Pirat et al<sup>18</sup> report a retrospective study in which they compared predicted to measured resting energy expenditure in 34 mechanically ventilated cancer patients. Walker and Heuberger<sup>19</sup> review the limitations of 7 equations to predict energy expenditure.

In the study by Pirat et al,<sup>18</sup> 76% of the subjects were post-surgery, and all the subjects had received mechanical ventilation for greater than 7 days. The 2 prediction equations used in this study agreed with the measured resting energy expenditure in 15% and 41% of the patients. These findings are consistent with the results of many studies, as cited Pirat et al.<sup>18</sup> Moreover, one might debate whether these findings are specific to mechanically ventilated cancer patients, given the limited number of subjects and findings consistent with other critically ill populations.<sup>1-3,5-8,13,16</sup> Interestingly, they did find that, if indirect calorimetry is not feasible, the Harris-Benedict basal energy expenditure equation *without* added stress and activity factors correlates better with measured resting energy expenditure than does the clinically estimated resting en-

ergy expenditure based on recommendations of the American Society for Parenteral and Enteral Nutrition.

Walker and Heuberger<sup>19</sup> reviewed the limitations of 7 equations to predict energy expenditure. They concluded that prediction equations applied to critically ill patients are rarely within 10% of the measured energy expenditure, and recommend that indirect calorimetry should be used to determine caloric needs in critically ill patients. Differing from Pirat et al,<sup>18</sup> Walker and Heuberger<sup>19</sup> do not recommend use of the Harris-Benedict equation. If a prediction equation must be used, Walker and Heuberger<sup>19</sup> favor the 1998 and 2003 Penn State equations, the 1992 Ireton-Jones equation, and the Swinamer equation.

Both papers<sup>18,19</sup> recommend the use of indirect calorimetry to determine the caloric needs of critically ill patients. But do they offer definitive evidence that indirect calorimetry should be the method to determine caloric requirements in critically ill patients? Is indirect calorimetry really the accepted standard? Pirat et al<sup>18</sup> measured resting energy expenditure for 30-min periods, and not continuously. Such short-term measurements may not reflect the total energy expenditure over 24 hours, because of changes in the patient's condition or activity level.<sup>20,21</sup> The quality of indirect calorimetry measurements on mechanically ventilated patients is open to question because of the technical challenges of interfacing with the patient and the ventilator.<sup>22-24</sup> Pirat et al<sup>18</sup> describe a number of quality-control measures they used to obtain reliable data, including inclusion/exclusion criteria for patient selection, hemodynamic status, ventilator settings, and measurement variability. Other deterrents to the use of indirect calorimetry include cost of the equipment, poor insurance reimbursement, and lack of trained personnel to operate the equipment.<sup>19</sup>

Do we need a randomized controlled trial to determine if indirect calorimetry improves outcomes for it to become standard practice in critically ill patients? That would be ideal, but to date it does not exist. The reliability of prediction equations to estimate the resting energy expenditure of critically ill patients is inadequate for the majority of patients. The treatment of patients based on their specific caloric requirements is important. As recommended by Pirat et al,<sup>18</sup> Walker and Heuberger,<sup>19</sup> and others,<sup>25,26</sup> I suggest that indirect calorimetry is the method of choice to

estimate caloric requirements in critically ill, mechanically ventilated patients.

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The author declares no conflicts of interest.

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