



# Comparison of Two Metabolic Simulators Used for Gas Exchange Verification in Cardiopulmonary Exercise Test Carts

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## Objectives

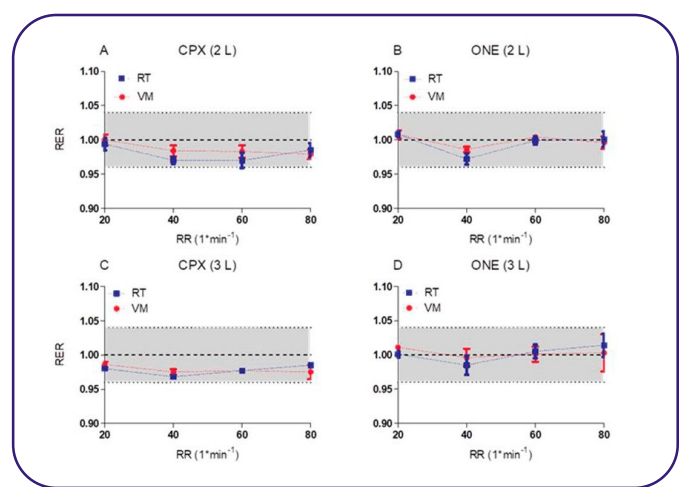
Metabolic simulators (MS) produce simulated human breaths for the purpose of verification of cardiopulmonary exercise test (CPET) equipment. MS should produce consistent identical breaths with known CO<sub>2</sub> and O<sub>2</sub> gas concentrations over a range of breath rates and tidal volumes. Reliability of a CPET metabolic cart depends on ongoing quality control and maintenance of the device, including intermittent verification with a MS. We compared two MS devices against two standard CPET systems.

## Study methods

The Vacumed 17056 (Vacumetrics, Ventura, CA) and Relitech (Relitech Systems BV, Nijkerk, The Netherlands) metabolic simulators were used with two standard metabolic carts (Vyntus™ CPX and Vyntus™ ONE, both Vyaire Medical, Mettawa, IL, United States) in random order. Simulated tidal volume (VT) was set at 2 and 3 L and breathing frequency ranged from 20 to 80 breaths per minute for each MS. At each set point, the authors measured three sets of 40 breaths. Primary outcome parameters collected were VT, oxygen consumption ( $\dot{V}O_2$ ), carbon dioxide production ( $\dot{V}CO_2$ ), and respiratory exchange ratio (RER).

## Results

Both metabolic simulators performed within specifications according to settings on both metabolic simulators. VT, RER (Figure 1),  $\dot{V}O_2$ , and  $\dot{V}CO_2$  results as obtained from both MS were all within the limits of acceptability, at both tidal volume settings, and all ventilatory rates. No significant trends were identified for either MS device. The Relitech MS produced tidal volumes that were closer to the target VT for both CPET carts at both VT and all rates, but the results of both MS were within acceptable ranges.



**Figure 1** Respiratory exchange ratio (RER) vs. respiratory rate (RR) for Vyntus™ CPX and Vyntus™ ONE measuring simulated breaths by Relitech (RT) and Vacumed (VM) simulators

## What is a CPET cart?

The CPET cart is simply a mobile workstation that brings together the equipment needed to perform metabolic testing during exercise. CPET provides assessment of the integrative exercise responses involving the pulmonary, cardiovascular, hematopoietic, neuropsychiatric, and skeletal muscle systems, which are not adequately reflected through the measurement of individual organ system function. This non-invasive, dynamic physiological overview permits the evaluation of both submaximal and peak exercise responses, providing the doctor with relevant information for clinical decision making. CPET is increasingly being used in a wide spectrum of clinical applications for the evaluation of undiagnosed exercise intolerance and for the objective determination of functional capacity and impairment. Its use in patient management is increasing with the understanding that resting pulmonary and cardiac function testing cannot reliably predict exercise performance and functional capacity and that overall health status correlates better with exercise tolerance than with resting measurements.



Figure 2 Vyntus™ CPX with cart

## Conclusion

In this study, both Vyntus CPET carts accurately analyzed simulated breaths produced by two standard metabolic simulators, creating comparable gas mixtures for O<sub>2</sub> and CO<sub>2</sub> over two different tidal volumes and a wide range of respiratory rates. Oxygen consumption, carbon dioxide production, and respiratory exchange ratio were consistently within manufacturers' specifications.

## Take home message

Based on this extended metabolic simulator testing, both Vyntus ONE and Vyntus CPX will deliver identical, accurate gas exchange assessment of subjects undergoing a maximal CPET.

### GLOBAL HEADQUARTERS

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