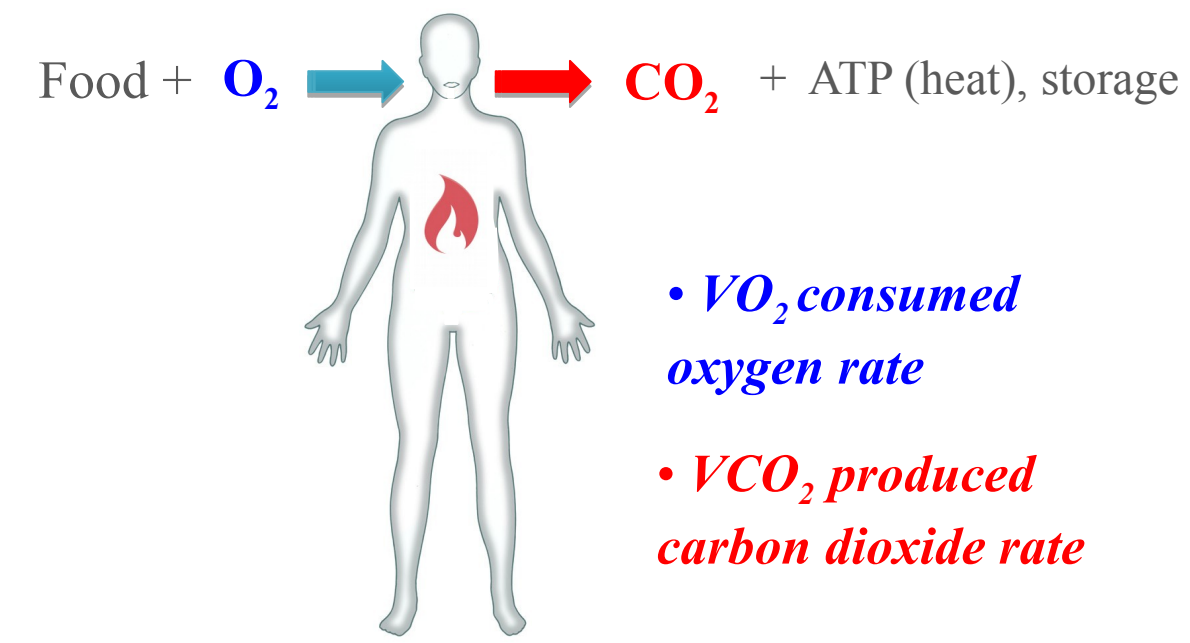


# An Integrative Personalized Professional Practice using a Validated Wearable Indirect Calorimeter

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The accuracy of **Breezing Pro/Med™** for resting metabolic parameters measurements as  $VO_2$ ,  $VCO_2$  and REE has been validated. This metabolic tracker helps healthcare providers assess the metabolic health of their patients and develop personalized weight management programs with better clinical outcomes. We have also proven that patients at home can use the mask device and assess their information remotely via HIPPA-compliant methods.



## Resting energy expenditure (REE) makes up more than 80% of total energy expenditure (TEE)

### Introduction:

Resting Energy Expenditure (REE) is defined as the energy necessary for basic natural body functions and it could be affected by factors as age, sex, BMI, etc. The knowledge of this metabolic parameter is valuable for weight management and for understanding of metabolic health.

**Breezing Pro/Med™** is a new device implemented for the comfortable measure of metabolic parameters based on indirect calorimetry method, in a 10 minutes breath test. We have reported a validation through the gold standard *Douglas Bag Method*, showing an excellent agreement between the two methods for REE,  $VO_2$  and  $VCO_2$  rates.\* In the present work we report for the first time the validation with a breath-by-breath reference metabolic cart, Medical Graphic Cart (MGC). In addition, we evaluate the system performance to monitor patients remotely at their homes during Stay-at-home order due to COVID-19 for a period of 30 days.

\* Mora SJ *et al.* (2020). *Glob J Obes Diabetes Metab Syndr* 7(1): 001-008.



$$\text{Intake Energy} = \text{Energy Expenditure} + \text{Stored Energy}$$

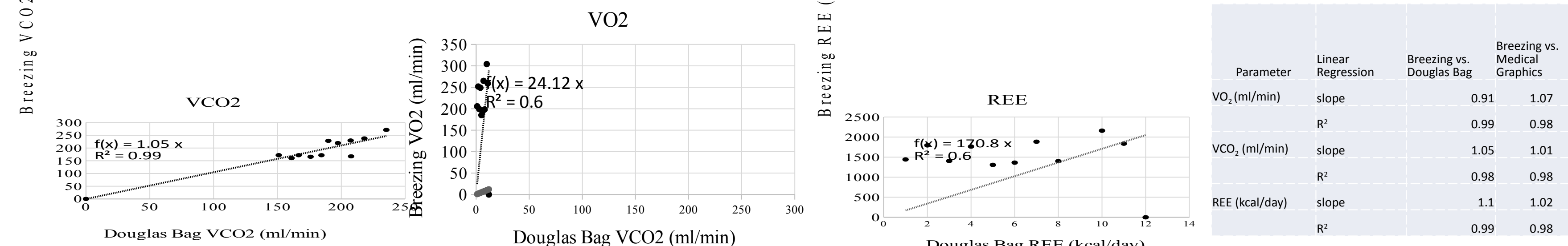
### Methods:

The validation was carried out over 20 healthy participants under resting conditions. The performance of Breezing Pro/Med™ was analyzed by measuring  $VO_2$ ,  $VCO_2$ , and REE in the same run experiment with three methods simultaneously by adapting and connecting the mask to the MGC and Douglas Bag Method (see **Fig. 1**). The results were compared and the correlation slope and R-squared coefficients for all of them were calculated. Telemedicine test were carried out by 6 ASU's students (see **Fig. 2**).

### Results:

- The comparative correlation plots for the metabolic parameters indicate a strong correlation between the two methods with  $R^2$  of  $\sim 0.9$ , and slopes of  $\sim 1$ .

The telemonitoring validation indicated that the user interface of the device was sufficiently user-friendly to guide the users at home.

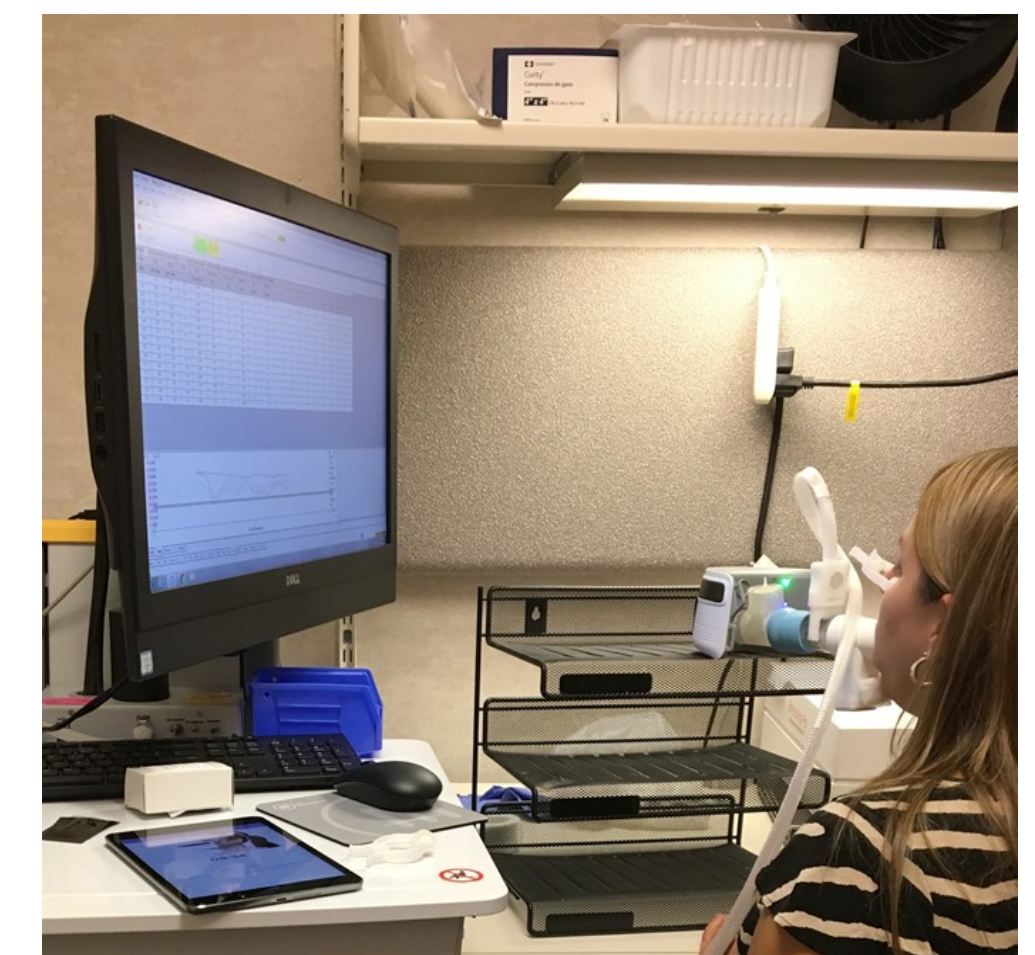


y = Correlation slope;  $R^2$  = Squared correlation coefficient; Mean difference and  $\pm$ SD (standard deviation) expressed as mL/min for  $VO_2$  and  $VCO_2$ , and kcal/day for REE.

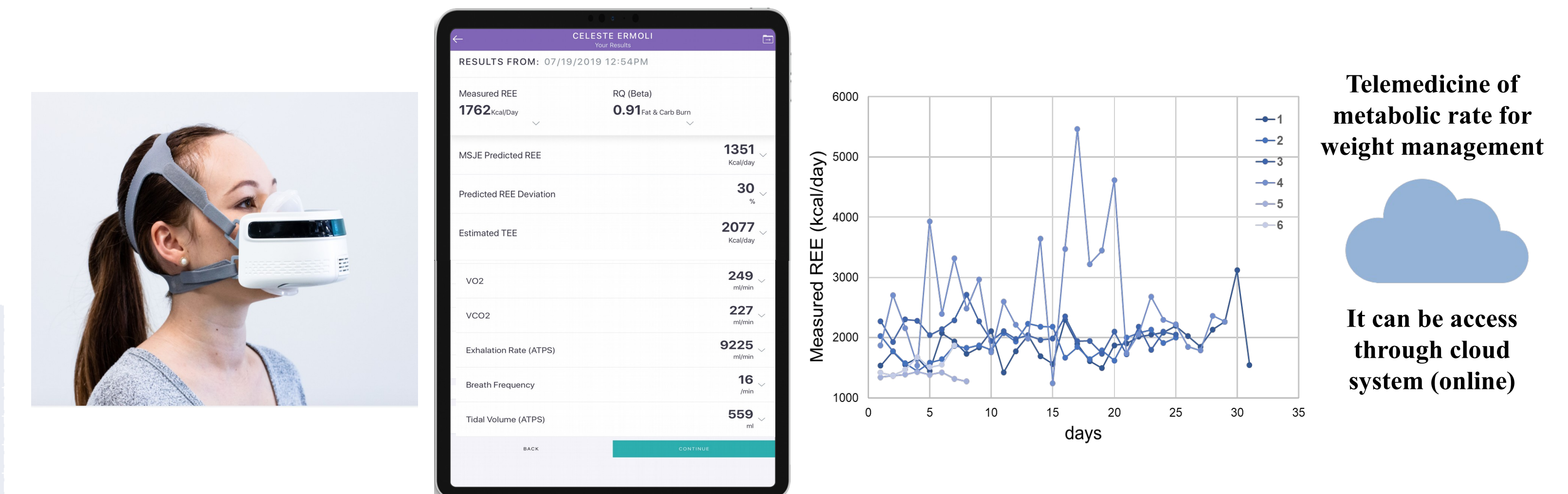
### Discussion:

The performance of Breezing Pro™ was analyzed by measuring  $VO_2$ ,  $VCO_2$ , and REE in the same run experiment with both methods simultaneously by adapting and connecting the mask to the MGC, and collection of breath for Douglas Bag Method. The results were compared and the correlation slope and R-squared coefficients for all of them were found to be close to 1.

Finally, a second validation on Telemedicine setting was carried out and have demonstrated the advantage over bulky and expensive equipment, improving the condition of measurement and yielding accurate values of metabolic parameters as  $VO_2$ ,  $VCO_2$ , and REE. The practical and easy use of this device makes **Breezing Pro/Med™** a valuable product for improving self-management at home.



**Fig. 1.** Picture shows the assembling of the mask connected to the MGC through a 2 one-way valve adapter followed by a preVent flow sensor. The preVent flow sensor is directly connected to the MGC by an umbilical adapter, and the subjects wore a tight fit mask. The environment was controlled to avoid any possible discomfort or nuisance during the test.



**Fig. 3.** Remote patient monitoring (from left to right): Comfortable wearable Breezing Pro/Med™ mask; Breezing Pro™ App's results; REE values determinate by Breezing Pro/Med™, self-follow-up by six subjects for a period of 30 days. Same data was collected for  $VO_2$ ,  $VCO_2$ , Breath frequency, exhalation rate and Tidal volume.

Telemedicine of metabolic rate for weight management



It can be access through cloud system (online)