



## **Some Patients Provide Very Little EBC. Why is This and What Can Be Done About It?**

EBC volume is primarily determined by the total volume of exhaled air that flows through the condenser and the efficiency of the condenser. The efficiency of the condenser is in turn affected by certain patient characteristics discussed below.

From most subjects, EBC volume is roughly 100-200 microliters per minute. We have found that it is uncommon for subjects to breathe through an EBC collector at what would be considered normal resting tidal flows and volumes. Instead, most patients breathe a bit more aggressively than usual, which is not the least bit harmful, and indeed increases the volume yield of EBC.

In general, patients who provide smaller volume (or no volume) samples fall into three groups. 1) people with severely restricted lungs, or severely obstructed airways, 2) small children who are breathing very quietly, 3) people who have not been instructed in a manner to optimize EBC collection.

What can be done to improve sample volume in these groups?

1. Assure that the patient is not exhaling through his/her nose.
2. Ask the patient to exhale strongly enough that he/she can hear her breath coming out the top of the RTube.
3. Chill the Aluminum sleeve down to  $-40^{\circ}$  or  $-80^{\circ}$ . Caution: some mediators may be collection-temperature dependent.  
IMPORTANT: DO NOT use sub-freezing temperatures when EBC pH is of interest.
4. Have the patients perform longer durations of collection.

The RTube was designed to function much better than other devices in regards to collection of EBC. Because of the dynamic cross-section of the RTube's expiratory valve, turbulence is encouraged in the condenser even at low flows. Turbulence is necessary to assure cooling of the exhaled airstream for condensation to occur, and to encourage impaction of the condensing droplets onto the collector surface. The exhalation valve then serves double duty as a syringe-style plunger, and is used to pool even small sample volumes off the condenser walls.

Nonetheless, the reality is that some subjects with very severe restriction of or obstruction (FEV1 of less than 25% predicted), can still have great difficulty in providing sufficient EBC sample. This is likely because the patients exhaled at such low flows and volumes that insufficient turbulence in the condenser occurs for the small amount of humidified exhalate going through the system.

But for most people without severe disease, assuring that the subjects breathe through their mouth and hear their own breath coming out of the top of the RTube should assure excellent sample volumes.