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Why Conventional Exhaled Breath Condensate pH Studies Cannot Provide Reliable Estimates of Airway Acidification

To the Editor:

In a recent article in *CHEST* (February 2011), the failure of Liu et al¹ to confirm earlier reports of decreased exhaled breath condensate (EBC) pH among patients with asthma² is disappointing but may have been inevitable because of some fundamental misconceptions in conventional EBC pH studies. Although EBC acidification is used to detect acidification of airway lining fluid (ALF), ALF pH cannot be estimated from EBC pH unless the buffer capacities of ALF and EBC are also known. It is likely that the principal buffers in ALF are nonvolatile and similar to those in plasma, primarily proteins and phosphates. In contrast, $\text{NH}_4^+/\text{NH}_3$ usually accounts for ~90% of buffering in EBC.^{3,4} Most of this volatile constituent is derived from the diffusion of gaseous NH_3 from saliva into exhaled air, and it is associated with the equilibration of CO_2 /bicarbonate (HCO_3^-) at ambient PCO_2 .^{3,4} Unfortunately, the relatively high concentrations of $\text{NH}_4^+/\text{NH}_3$ and $\text{CO}_2/\text{HCO}_3^-$ found in most EBC samples overwhelm any effects that metabolic acids in the minuscule amounts of ALF present in EBC can have on EBC pH. It has been argued that because changes in NH_4^+ concentration have a relatively modest effect on EBC pH, they can be ignored.⁵ This is patently incorrect because changes in buffer concentrations typically have modest effects on pH but have profound effects on buffer capacity. The buffer capacity of EBC must increase with NH_4^+ , thereby reducing any impact that ALF acids have on EBC pH.

Conventional EBC pH studies also fail to consider or measure the dilution of ALF by condensed water vapor, which is large and variable (~5,000-20,000 fold). The effect of nonvolatile acids in ALF on EBC pH will obviously be less when the dilution is increased. In view of the dominance of oral NH_3 on EBC pH, investigators should measure specific ions in EBC (eg, lactate), indicating metabolic acids from the ALF. Furthermore, sensitive amylase measurements should be routinely made to estimate salivary contamination.³ Some low EBC pH values that have been reported may reflect acid reflux, suggesting that gastric markers should also be measured. Efforts to remove CO_2 by bubbling argon through the EBC^{1,2} are unwise because measurements are not made of the effects of purging on CO_2 , $\text{NH}_4^+/\text{NH}_3$, water, or other volatile constituents. Unless these problems are addressed,

it is unlikely that EBC pH will ever become a reliable indicator of pulmonary airway acidosis or inflammation. The expenditure of additional time and scarce resources on conventional EBC pH measurements would, therefore, seem unjustified.

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Probiotics in United Airways Disease

To the Editor:

I read with great interest the article by Forsythe¹ in a recent issue of *CHEST* (April 2011). The author reports that probiotics are not shown to be beneficial in the treatment of asthma. This holds true for the preventive effect, but not the therapeutic effect, of probiotics. I agree with the author that clinical trials have not shown beneficial effects of probiotics in patients with asthma. But, at the same time, children having concomitant asthma and allergic