THE RELATIONSHIP OF LUNG SOUND AMPLITUDE AND DURATION TO VOLUME AND FLOW
R. Murphy, F. Davidson, C. House, V-A Power, C. Wilson and A. Vyshedskiy, Faulkner and Lemuel Shattuck Hospitals, Boston, MA

PURPOSE
The purpose of this investigation was to determine whether variations in lung sound amplitude and duration measured over the chest wall reflect variations in tidal volume and flow rate delivered by a positive pressure ventilator.

METHODS
- 16 channels over the posterior and lateral chest, I over the trachea, 1 over the heart.
- Gentex microphones imbedded in stethoscope chest pieces.
- Chest pieces imbedded in soft foam pad.
- Subjects sitting upright in a chair.
- Custom software (Stethographics, Inc).
- Tidal volumes of 400, 800, AND 1200 cc’s were respired
- Flow Rates: 40, 60, 80, 100, 120, 140 l/min

RESULTS
<> RMS increased with increasing flow at each input tidal volume at the trachea and all chest sites.  
<> At tidal volumes of 400 and 800 cc’s (physiologic range), the relationship of RMS x time of inspiration to flow at each chest site was flat despite changes in flow.  
<> RMS x time increased with increasing tidal volume.

EXPIRATORY RMS AND RMS x TIME
The RMS and RMS x TIME of the expiratory sound was unrelated to the input flow and volume (Data not shown).

RELATIONSHIP BETWEEN FLOW AND SOUND AMPLITUDE
SPONTANEOUS BREATHING

RELATIONSHIP BETWEEN FLOW AND RMS AT THE TRACHEA.
The subject was asked to breath freely at different flows. Note that expiratory sound is louder than inspiratory sound. Note the linear relationship between the RMS and the Flow.

RELATIONSHIP BETWEEN FLOW AND RMS AVERAGED FROM 14 SITES ON THE CHEST.
The subject was asked to breath freely at different flows. Note that the lung sounds are louder during inspiration. Note the linear relationship between the RMS and the Flow.

VENTILATED SUBJECTS

CONCLUSION
Lung sound analysis can provide information from sites over the chest that reflects changes in flow and volume delivered by a ventilator. Although these results are preliminary, they offer the promise of improved monitoring of patients on ventilators.