

## Maximizing interpretable heart sounds in the Emergency Department using digital auscultation and computerized analysis

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Abstract / Text:

**Background:** Use of stethoscope-based digital phonocardiography for detection of added heart tones (S3, S4) in the ED environment has been limited by high noise/signal ratio (NSR). Accurate computer recordings would aid diagnosis of cardiac abnormalities. **Objectives:** To determine the optimal combination of patient position, auscultation location, and stethoscope type capable of minimizing NSR. **Methods:** We tested 2 patient positions (semi-supine vs left lateral decubitus), 2 auscultation locations (pulmonic vs mitral), and 2 digital stethoscopes (ThinkLabs ds32a vs WelchAllyn Meditron, both recorded to computer) in a tertiary care ED during 2007-2008. Four trained operators performed 8 recordings on each of 88 healthy volunteers. To account for similarities within patients and operators, a linear mixed model was fit to determine what combination of parameters minimized NSR. Correlation and agreement between raters was assessed using Spearman's rho and Bland-Altman plot, respectively. Multivariable mixed modeling was used to assess the influence of operator and subject-specific characteristics. **Results:** Subjects had a median age of 24 years (IQR 23 to 34) and 37 (42%) were male. After multivariate analysis, a significant decrease in NSR was observed with the semi-supine position, ds32a stethoscope, and mitral location (Table).

Covariate	Absolute Change in NSR	SE	95% CI	P
Semi-supine position	-1.93	0.663	(-3.23, -0.63)	0.012
ThinkLabs stethoscope	-3.43	0.663	(-4.73, -2.13)	<0.0001
Mitral location	-4.98	0.661	(-6.28, -3.69)	<0.0001

Table 1

Correlation (Spearman's rho = 0.86) between raters was high. A Bland-Altman plot indicated good agreement between raters' average NSRs per subject with 94% of measurements within the limits of agreement. Operator was strongly associated with average NSR, while ED room, BMI, sex, and age were not.

**Conclusions:** Auscultating with the ds32a stethoscope in the mitral location with the subject semi-supine produced the best (lowest NSR) recordings.