

Title: Improving the Stethoscope: Optimizing Computerized Analysis of Heart Tones in Emergency Department Patients With Possible Heart Failure

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Body: While computerized analysis of digitally captured heart tones has shown promise, practical translation of this technology to emergency department (ED) patients with acute dyspnea is challenging. We used a computerized noise score to estimate the suitability of recorded heart tones to identify the presence of added sounds (S3 or S4).

A ThinkLabs Electronic Stethoscope was used to digitally record heart tones at 30-90 degrees in the 4th or 5th left intercostal space in 159 ED patients over 50 years old with signs and symptoms of possible heart failure. Phonocardiograph Monitor software was used to blindly test 212 recordings for suitability to detect an added (S3 or S4) heart tone by establishing a noise score (% of noise relative to the maximum signal amplitude). Noise scores were defined a priori as: <6 good, 6-12 fair, 12-20 poor, and >20 unacceptable.

Mean noise score \pm SD was 16.38 \pm 10.7. Unacceptable scores were present in over a fourth of patients (Table). There was no significant difference between the subgroup measured from 30 to 45 degrees and those > 45 degrees (t test, p = 0.59). Trained operator experience also suggested that while ED ambient noise could be largely eliminated, physiological sounds (e.g. breathing, patient movement) and technical issues (stethoscope position, investigator movement) were responsible for noise.

Computer analysis for added heart tones can be achieved in acutely ill ED patients but has a high percentage of noise. Optimal technique for capture of heart tones consistently acceptable for digital S3 and S4 analysis requires further refinement before widespread clinical adoption.

Percent (N) of Noise Score Categories				
	Good	Fair	Poor	Unacceptable
All (n=212)	10.9 (23)	30.2 (64)	31.1 (66)	27.8 (59)
30-45 degrees (n=159)	11.9 (19)	30.8 (49)	28.3 (45)	28.9 (46)
> 45 degrees (n=53)	7.5 (4)	28.3 (15)	39.6 (21)	24.5 (13)