

## Diagnostic accuracy of modalities for acute heart failure in emergency settings: a systematic review and diagnostic accuracy meta-analysis

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**Background:** Acute heart failure diagnosis in emergency departments remains challenging. This systematic review and meta-analysis compared four diagnostic approaches: clinical assessment, biomarker assessment, basic ultrasound assessment, and advanced ultrasound assessment.

**Methods:** PubMed/MEDLINE, Scopus, Google Scholar, Cochrane Library, Google Scholar, and Web of Science were searched up to December 2024. Eligible studies evaluated acute heart failure diagnostic modalities in emergency settings and provided data for 2 × 2 contingency tables. Two independent reviewers conducted screening, data extraction, and QUADAS-2 quality assessment. Diagnostic accuracy was pooled using a bivariate random-effects model. SROC curves, pooled sensitivity, specificity, and AUC with 95% confidence intervals (CI) were calculated. Heterogeneity was assessed using I<sup>2</sup> statistics and publication bias with Deeks' funnel plot.

**Results:** Thirty-three studies including 17 participants to 1,586 participants met the inclusion criteria. Clinical assessment showed moderate performance (AUC = 0.591), limited sensitivity (0.500, 95% CI: 0.484-0.515), and high specificity (0.858, 95% CI: 0.830-0.886). Biomarker assessment demonstrated excellent performance (AUC = 0.906), high sensitivity (0.874, 95% CI: 0.872-0.875), and good specificity (0.781, 95% CI: 0.778-0.783). Basic ultrasound assessment showed moderate performance (AUC = 0.750), low sensitivity (0.349, 95% CI: 0.303-0.395), and high specificity (0.889, 95% CI: 0.874-0.904). Advanced ultrasound assessment demonstrated excellent performance (AUC = 0.892), good sensitivity (0.713, 95% CI: 0.705-0.720), and very high specificity (0.903, 95% CI: 0.900-0.905). All modalities showed consistent performance (I<sup>2</sup> = 0%).

Clinical assessment alone was less sensitive, whereas combining biomarkers and advanced ultrasound may improve diagnostic decision-making in emergencies.

**Conclusion:** Biomarker assessment had the highest overall accuracy, while advanced ultrasound assessment provided the best sensitivity-specificity balance, supporting multimodal emergency diagnosis.

**Keywords:** Acute heart failure, emergency department, biomarkers, ultrasound, diagnostic accuracy, meta-analysis, clinical assessment, advanced ultrasound.