

Article

Point-of-Care Ultrasound (POCUS) to Assess Volume Status in Hospitalized Patients with Acute Decompensated Congestive Heart Failure

Justin Dizon ¹, Julie Sakowski ² , Paula Geigle ³ and Charles Scott Mahan ^{3,*} ¹ Department of Medicine, Mission Hospital, Asheville, NC 28801, USA; justindizon92@gmail.com² Department of Health Care Management, Appalachian State University, Boone, NC 28608, USA; sakowskija@appstate.edu³ Department of Medicine, Charles George Veterans Medical Center, Asheville, NC 28805, USA; geigle@comcast.net

* Correspondence: charles.mahan@va.gov

Abstract

Accurate assessment of volume status in acute decompensated heart failure (ADHF) remains challenging. Point-of-care ultrasound (POCUS) offers a rapid, non-invasive approach to directly evaluate venous and pulmonary congestion. In this exploratory study, 25 veterans admitted with ADHF underwent serial POCUS examinations of jugular venous pressure (JVP), inferior vena cava (IVC) diameter and collapsibility, and pulmonary B-lines. Pulmonary B-lines were measured using a novel 4-quadrant method. Daily clinical assessments and laboratory data were used to adjudicate volume status. Associations between POCUS findings and clinical congestion were analyzed using chi-square testing. Twenty-four patients were included in the final analysis (mean age 76 years; 96% male; mean BMI 30.86 kg/m²). Elevated JVP on POCUS (≥ 10 cm H₂O) and IVC diameter > 21 mm were strongly associated with clinical volume overload ($p < 0.001$ for both). B-lines showed no significant association ($p = 0.806$). Obesity limited bedside JVP evaluation but did not affect POCUS JVP acquisition. Combined JVP + IVC positivity produced the highest diagnostic concordance with overload status ($p < 0.001$). POCUS assessment of JVP and IVC diameter provided a feasible and reliable method for evaluating congestion in hospitalized patients with ADHF. A novel four-quadrant method of lung ultrasound offered limited additional value.

Keywords: POCUS; congestive heart failure; volume status; jugular venous pressure

Academic Editor: Ljupcho Efremov

Received: 28 May 2026

Revised: 16 June 2026

Accepted: 22 June 2026

Published: 1 July 2026

Copyright: © 2026 by the authors.

Licensee MDPI, Basel, Switzerland.

This article is an open access article distributed under the terms and conditions of the [Creative Commons Attribution \(CC BY\)](https://creativecommons.org/licenses/by/4.0/) license.

1. Introduction

Accurate volume status assessment for hospitalized individuals with acute decompensated heart failure (ADHF) is a difficult clinical challenge. The definitive method to ascertain volume status is cardiac catheterization with measurement of both left and right sided pressures. However, performing catheterization in all patients admitted for acute decompensated heart failure is not feasible due to the invasive test nature. Surrogate markers of volume status are the primary means of initially diagnosing ADHF and for guiding therapy. Clinical surrogates, which include the presence or absence of peripheral edema, jugular venous distention (JVD), pulmonary crackles, and S3 heart sounds are useful but are limited by subjectivity and interobserver variability [1].

Laboratory parameters such as brain natriuretic peptide (BNP) levels and trending of renal function provide complementary information but without clinical patient presentation data are limited in defining intravascular congestion [2]. Consequently, clinicians often struggle to determine true volume status, leading to under-diuresis, persistent congestion, premature discharge, and subsequent readmission.

Recent guidelines from the American Heart Association, American College of Cardiology, and Heart Failure Society of America emphasize establishing optimal volume status before discharge, and identified residual congestion as a predictor of mortality and early readmission [3]. Thus, more objective and reproducible tools for bedside volume assessment are needed.

Point-of-care ultrasound (POCUS) has emerged as a non-invasive, rapid, and portable tool complementing the physical examination by directly visualizing markers of ongoing congestion. POCUS can estimate jugular venous pressure (JVP), measure inferior vena cava (IVC) diameter and collapsibility, and quantify pulmonary B-lines. Prior studies reported B-line counts correlate with pulmonary congestion, and a persistently dilated, non-collapsible IVC at discharge predicts higher readmission risk [4–7]. Volpicelli et al. stated daily lung ultrasound performed comparably to serial chest radiography for guiding diuretic therapy in acute diastolic heart failure [4], while Goonewardena et al. found an enlarged IVC size and lack of collapsibility predicted readmission following ADHF hospitalization [5]. Furthermore, ultrasonographic estimation of JVP corresponded closely with right atrial pressure, providing a reliable surrogate for invasive hemodynamic measurements [6].

A 2024 targeted literature review by Yampolsky et al. analyzed 15 studies involving POCUS-based IVC assessments in ADHF demonstrated combining IVC measurements with lung ultrasound achieved diagnostic sensitivities and specificities approaching 90–100% for identifying heart failure, while changes in IVC diameter after diuretic administration correlated significantly with therapeutic response. They concluded that POCUS is an effective tool in ADHF diagnosing and monitoring response to therapy [8]. Malagon et al. demonstrated residual congestion identified by POCUS at discharge, particularly persistent B-lines or dilated IVC, strongly predicted 30-day readmission among patients with ADHF [9].

Despite encouraging results from prior studies; a simple, tailored POCUS protocol for evaluating volume status during inpatient ADHF management does not exist. Furthermore, most prior studies were conducted in the emergency department or critical-care settings rather than general medical wards. Evidence within the veteran population also remains limited.

This exploratory study evaluated the feasibility of using POCUS-derived measurements (JVP, IVC diameter and collapsibility, and pulmonary B-lines) as a means to monitor volume status among hospitalized veterans diagnosed with ADHF. We sought to determine (1) which POCUS variables most closely align with clinical assessments and (2) if routine inpatient POCUS use could improve clinicians' ability to recognize congestion and monitor therapeutic response.

2. Materials and Methods

Between October 2023 and March 2025, twenty-five participants diagnosed with acute decompensated congestive heart failure participated in a prospective non-randomized longitudinal exploratory study examining POCUS utilization to assess volume status. Participants were recruited from Veterans admitted to the Charles George VA Medical Center with decompensated congestive heart failure. Enrollment required assessment by the study's lead investigator within twenty-four hours of admission. All Veterans signed informed consents. In accordance with prespecified criteria, at least two measurements of

volume status were required to be included in the final data analysis. Twenty-four of the twenty-five enrolled subjects met these criteria.

Blinded to the hospitalist's daily clinical assessment, the study's lead investigator performed all POCUS exams. The treating hospitalists were likewise blinded to the POCUS results. As per the study protocol, the treating hospitalists ordered daily weights, the nursing collection of daily input and outputs, and they documented daily jugular venous distension, the presence of lung crackles, lower extremity edema, and a daily qualitative overall assessment of volume status. These daily recordings allowed the investigators to retrospectively determine volume status for each time point when POCUS evaluations were completed. Specifically, the combination of clinically elevated JVP, rales on exam, lower extremity edema, change in weight, and clinician's impression of volume status weighed heavily in retrospective clinical adjudication of volume status. In addition, measurements of serum creatinine, serum bicarbonate, cardiac echocardiogram, and chest radiograph results were recorded to assist with a global assessment of volume status.

The POCUS examinations were performed using a General Electric Vscan Extend R2 Dual Probe Handheld Portable Ultrasound® (GE HealthCare, Horten, Norway). The device is the size of a large cell phone with an attached dual probe with both phased and linear array transducers. The linear transducer on the vascular setting was used to evaluate JVP. The phased transducer was set on the abdominal setting while assessing B-lines and IVC diameter and collapsibility.

POCUS evaluations were performed at least twice weekly, and up to daily, until discharge. Observations per participant ranged from 2 to 8 with a mean of 4.5 observations, based on the stay length and time required to reach euvolemia. The POCUS observations were obtained daily on every third hospital day until the hospitalist determined clinical euvolemia was reached. POCUS evaluations included Jugular Venous Pressure of the right and/or left internal jugular veins (obtained with the patient at 45 degrees and upright at 90 degrees). Pulmonary B- lines were assessed using a 4-quadrant method, modified from Platz et al., with the patient at 45 degrees [10]. The four quadrants included the upper anterior chest between the 2nd and 4th intercostal spaces, both to the right and left of the sternum, and inferior and lateral to the nipple in the anterior axillary line bilaterally (approximately the 4–5th intercostal space). The measurement of >2 B-lines in 2 or more quadrants indicated a positive result [11]. Utilization of a 4-quadrant method arose from the desire to balance diagnostic accuracy with real-world feasibility. In the inpatient setting, scanning protocols requiring 8–12 lung zones are time-consuming, limiting implementation. Furthermore, prior work suggests a simplified 4-quadrant method reliably detects pulmonary congestion [10]. Inferior vena cava diameter and collapsibility were assessed using a subcostal view measured proximally to the hepatic vein entry [10].

Statistical analysis was performed using Pearson's chi-squared analysis. Sensitivity and Specificity confidence intervals are exact Clopper–Pearson intervals. Predictive value confidence intervals are standard logit intervals as described in Mercaldo et al. (2007) [12]. All confidence intervals were calculated using www.medcalc.org/en/calc/diagnostic_test.php (accessed on 15 June 2026).

POCUS results were compared to the daily, qualitative global clinical volume status (as determined by the study's lead investigator using the clinical assessments of the hospitalists and recorded lab parameters). POCUS evaluator confidence in his POCUS measurement was also recorded, reflecting the quality of images acquired which included confounders such as body mass index, age, or valvular heart disease.

3. Results

Final analysis included twenty-four Veterans, as one Veteran had withdrawn status post an acute cerebrovascular event. Baseline characteristics are summarized in Table 1.

Table 1. Patient characteristics.

Characteristic	N	%
Male	23	96%
Female	1	4%
Age, mean (95% confidence interval)	76 (72.4–79.6)	
60–70 yrs old	5	20%
70–80 yrs old	11	48%
80–85 yrs old	5	20%
>85 yrs old	3	12%
Body Mass Index		
BMI, mean (95% confidence interval)	30.86 (27.41–34.31)	
BMI ≥ 30 kg/m ²	12	50%
Ejection Fraction		
HFpEF (EF > 50%)	5	21%
HFmrEF (EF 40–50%)	4	17%
HFrEF (EF < 40%)	15	62%
Clinical Congestion Markers on Admission		
Elevated JVP	14	58%
JVP not elevated	4	17%
Could not assess JVP	6	25%
Lung crackles present	15	63%
Lung crackles absent	8	33%
Edema present	21	88%
No edema	3	12%
Clinically Adjugated Volume Status on Admission		
Overloaded	21	88%
Euvolemic	1	4%
Not recorded	2	8%

The mean age was 76 years, predominantly male, with a single female patient. The mean BMI was 30.86 kg/m², with 50% meeting the criteria for obesity. Most Veterans exhibited reduced left ventricular systolic function with 19 ejection fractions less than 50%.

Clinical congestion markers were documented on Veteran admission, with lower extremity edema documented in 88% and elevated JVP in 58%. Lung crackles were noted in 63%, while an additional 17% displayed decreased lung sounds. Overall, treating physicians assessed 21 Veterans as volume overloaded on initial admission.

When adjudicated by the lead investigator, only one Veteran presented with clinical euvolemia on admission. He was admitted with a diagnosis of acute decompensated heart failure despite the disparate initial clinical findings.

Operator confidence for each POCUS evaluation is shown in Table 2. JVP visualization by POCUS demonstrated the highest operator confidence, with 89% of evaluations rated

as good confidence and none as poor. Only 64% of B-line examinations were rated as good confidence, while 33% were rated as fair. IVC POCUS evaluation offered the lowest operator confidence, with only 59% good confidence reported and 25% rated as poor, usually due to body habitus or unfavorable acoustic windows. Poor visualization of B-lines occurred in 4 of the 24 patients (16.7%), and visualization of the IVC was limited (poor) in 8 of the 24 patients (33.3% body habitus appeared to impact IVC diameter visualization more than B-line acquisition. The ability to clearly appreciate B-lines varied within the same patient based upon exam day, while in general if determining the IVC diameter was difficult once, it tended to remain that way throughout hospitalization.

Table 2. Confidence in POCUS measurements. Poor confidence indicates difficulty obtaining adequate visualization, most commonly due to technical limitations.

Measure	Good	Fair	Poor
JVP	95 (89%)	12 (11%)	-
B-lines	69 (64%)	33 (31%)	5 (5%)
IVC diameter	63 (59%)	17 (16%)	27 (25%)

Diagnostic performance of individual POCUS studies is summarized in Table 3. The investigators assessed how accurate POCUS diagnosed volume overload was in persons with confirmed clinical volume overload. For example, if a good or fair quality POCUS study was obtained, how likely did it agree with clinically adjudicated volume overload status. The criteria for a positive POCUS study were >10 cm for JVP exam, >2 B-lines in 2 or more quadrants, and IVC Diameter of >21 mm. Elevated JVP by POCUS strongly associated with clinically adjudicated volume overload and correctly identified volume overload in 83% of cases. POCUS exam for JVP demonstrated 83% [73.6–90.6%] sensitivity and 70% [47.1–86.8%] specificity for volume overload (PPV = 91%, NPP = 53%). IVC diameter greater than or equal to 21 mm also demonstrated a similarly strong association, correctly identifying overload in 89% (55/62) of patients. The main limitation of IVC diameter was 33% of Veterans or 25% of the exams performed, a quality exam could not be achieved. When successfully obtained, the sensitivity of the test was 89% and the specificity was 67% [41.0–86.7%] (PPV = 90%, NPV = 63%). In contrast, the presence of greater than 2 B-lines in 2 or more zones on a simplified 4-zone lung ultrasound did not discriminate between overloaded and non-overloaded patients (sensitivity = 93% [84.4–97.2%], specificity = 9% [1.1–29.2%], PPV = 79%, NPV = 25%).

Table 3. Diagnostic performance of individual POCUS measurements for identifying volume overload.

POCUS Variable	N Observations with Positive * POCUS Reading & Overload	N Observations Overloaded	% Good/Fair Readings Correctly Identifying Overload *	p-Value	Positive Predictive Value [95% Confidence Interval]	Negative Predictive Value [95% Confidence Interval]
Elevated JVP	70	84	83%	0.000	91% [84.3–94.9%]	53% [39.8–66.4%]
≥2 b-lines present	74	80	93%	0.806	79% [76.2–81.1%]	25% [6.7–60.6%]
IVC diameter > 21 mm	55	62	89%	0.000	90% [82.6–94.7%]	63% [44.2–78.8%]

* Positive POCUS variable read with good or fair confidence.

Combined POCUS assessments and respective diagnostic performance are summarized in Table 4. Combining the results from more than one POCUS study aspect (JVP, B-lines, IVC) led to improved specificity at the expense of sensitivity (JVP/B-lines 78% sensitivity [66.8–86.1%], 68% [45.1–86.1%] specificity; IVC/JVP 79% sensitivity [66.8–88.3%], 78% specificity [52.4–93.6%]; IVC/B-line 83% sensitivity [71.3–91.1%], 67% [41.0–86.7%] specificity; JVP/B-line/IVC 72% sensitivity [58.6–82.6%], 76% [50.1–93.2%] specificity). Positive predictive value for each combination of studies was >90%, but NPV was 52% or less for each pairing.

Table 4. Diagnostic performance of combined POCUS measures for identifying volume overload.

Combined POCUS Criteria	N Observations with Positive * POCUS Reading & Overload	N Observations Overloaded	% Correct Identifying Overload *	p-Value	Positive Predictive Value [95% Confidence Interval]	Negative Predictive Value [95% Confidence Interval]
JVP elevated+ ≥ 2 b-lines	62	80	78%	0.000	90% [82.6–94.3%]	45% [33.6–57.8%]
JVP elevated+ IVC ≥ 21 mm	49	62	79%	0.000	92% [83.6–96.7%]	52% [38.5–65.0%]
IVC ≥ 21 mm+ ≥ 2 b-lines	49	60	81%	0.000	90% [82.0–94.5%]	52% [36.8–67.2%]
All POCUS measures positive	43	60	72%	0.000	91% [81.8–96.3%]	43% [32.1–55.3%]

* Positive POCUS variable read with good or fair confidence.

We also assessed whether right-sided heart valve disease or obesity impacted the clear acquisition of POCUS JVP measurement, as determined by confidence in the acquired image. Supplemental analyses indicate these variables did not substantially impact POCUS-based estimation of jugular venous pressure. The presence of tricuspid regurgitation was not associated with reduced operator confidence in POCUS JVP assessment, suggesting POCUS remains feasible in patients with right-sided valvular disease (Supplemental Table S1). Similar to published findings, obesity significantly impaired bedside clinical JVP assessment (Supplemental Table S2a) but produced no effect on confidence in POCUS JVP assessment (Supplemental Table S2b). Together, these supplemental analyses highlight the potential advantage of POCUS for JVP measurement over traditional clinical examinations in persons with obesity.

4. Discussion

In this exploratory study of hospitalized Veterans with acute decompensated heart failure, point-of-care ultrasound (POCUS) assessment of jugular venous pressure (JVP) and inferior vena cava (IVC) diameter demonstrated a strong association with clinically adjudicated volume overload. In contrast, POCUS of the lungs using our novel four-zone B-line protocol showed limited additional utility. Thus, targeted evaluation of JVP and IVC offers the most practical and reliable POCUS strategy for assessing volume status in patients with ADHF in general inpatient settings.

Several clinical implications emerge from this exploratory study. First, POCUS evaluation of JVP and IVC provided objective congestion measures which were further reinforced by combining multiple clinical variables. Notably, JVP by POCUS could be reliably assessed in every Veteran, even when standard bedside clinical estimation was unable to be obtained due to obesity or neck anatomy. Work by Pettit et al. demonstrated that novice clinicians can accurately assess JVP via POCUS in obese patients after a brief training period [13]. In contrast, clinical assessment of JVP can be challenging. This is illustrated by the 25% of Veterans whose JVP could not be assessed at baseline in our study.

Second, IVC diameter greater than 21 mm was a robust indicator of volume overload, reinforcing prior evidence that IVC diameter is a key indicator of elevated right-sided filling pressures and ongoing decompensated heart failure. Additionally, combining different POCUS evaluations improved the positive predictive values for determining volume overload status, but led to lower negative predictive values (Tables 3 and 4). When clear images (good/fair confidence) were obtained (Table 2), the combination of positive measures by POCUS showed a strong association with clinically adjudicated volume overload.

Third, while lung ultrasound for pulmonary B-lines is a valuable tool in acute and emergency settings, the use of eight-to-twelve-zone methods may limit everyday application on a busy hospital ward. Unfortunately, our attempt at a modified 4-zone method failed to show an association between measured B-lines and clinician-determined volume status. The B-line measurement's low specificity may be attributed to assessing only 4-zones. By sampling fewer intercostal spaces, the 4-zone method may miss localized pulmonary edema, possibly captured with more comprehensive protocols.

This study demonstrated that a focused POCUS protocol, limited to JVP and IVC assessments, could potentially augment daily inpatient rounds in assessing acute decompensated heart failure. The portability and the relatively modest learning curve for a POCUS examination compared to formal ultrasound studies make POCUS accessible to hospitalists and trainees [14]. Standardized use of focused protocols may reduce inter-provider variability in congestion assessment, improve precision in diuretic titration, and enhance residual volume overload detection [14]. By shifting volume assessment from subjective assessment to reproducible imaging, integration of focused POCUS may provide improved inpatient heart failure management and mitigate the high early readmission risk characteristic [15].

Several limitations should be acknowledged. Veterans participating represented a convenience sample, limiting in-depth statistical analysis. Twenty to twenty-five patients provided a reasonable sample for technique feasibility and facilitated impetus for further study. Also, the analysis included repeated measures, with unequal measurements across Veterans primarily due to length of stay and time until clinical euvolemia. Despite repeated measures, the POCUS variables and the clinical variables were independent within each patient and as a group. We realize the Pearson chi-square analysis limitations for repeated measures, and thus, the results should be considered exploratory. This exploratory study occurred at a single Veterans Affairs Medical Center with a small, predominantly male cohort, thereby limiting generalizability. Furthermore, all POCUS examinations were performed by a single experienced operator, thus limiting inter-observer variation, but also possibly limiting applicability to less experienced POCUS utilizers. A single POCUS examiner benefit offered unified technique and consistent methodology. The disadvantage is the difficulty in ascertaining whether other operators obtain similar results. Another limitation includes clinical parameters to determine volume status rather than invasive hemodynamics as a "gold standard" comparator. Our findings demonstrate an association between the POCUS studies performed and clinically adjudicated volume status rather than

implying definitive diagnostic performance. Investigators chose to utilize readily available clinical variables, similar to real-world conditions, less invasive and more accessible. Lastly, lung ultrasound was restricted to four anterior-lateral zones, potentially underestimating pulmonary congestion compared to eight- or twelve-zone protocols.

This exploratory study suggests that a focused POCUS evaluation with a handheld ultrasound is a reasonable and accessible tool for assessing volume status in acute congestive heart failure. Future work should expand upon these findings through multicenter trials evaluating standardized inpatient POCUS protocols performed by multiple operators. The clinical importance is the 2025 study by Maganti et al. which reported an association between POCUS use and reduced length of stay at a single facility study [16].

Further studies integrating serial JVP and IVC measurements with biomarkers such as BNP and with outcomes including length of stay, readmission, and mortality would clarify the prognostic value.

5. Conclusions

In this inpatient Veteran population with acute decompensated heart failure, POCUS assessment of JVP and IVC demonstrated a strong association with clinical volume status. Lung ultrasound using a simplified protocol showed limited diagnostic utility. A focused POCUS protocol may offer clinicians a practical adjunct for guiding diuretic therapy and determining discharge readiness in hospitalized patients with acute decompensated heart failure.

Supplementary Materials: The following supporting information can be downloaded at <https://www.mdpi.com/article/10.3390/phc25020008/s1>. Table S1. Association between Tricuspid Regurgitation (TR) and POCUS JVP Confidence; Table S2. (a) BMI and ability to clinically assess JVP; (b) BMI and Confidence in POCUS-Based JVP Assessment.

Author Contributions: C.S.M. was the principal investigator of the study. He was involved in the conceptualization of the study, investigation, methodology, data curation, and writing of the manuscript. J.D. was involved in writing the initial draft of the manuscript. J.S. provided the statistical analysis for the study and contributed to manuscript review. P.G. assisted with study conceptualization, project administration, and review of the final manuscript. All authors have read and agreed to the published version of the manuscript.

Funding: The lead investigator is an employee of the Charles George VA Medical Center. No additional funding was earmarked for this study. The content does not purport to reflect the views of the Medical Center. The funding source played no role in the study design; in the collection, analysis, and interpretation of data; in the writing of the report; or in the decision to submit the report for publication.

Institutional Review Board Statement: The study was conducted in accordance with the Declaration of Helsinki and approved by the Institutional Review Board of the Charles George VA Medical Center (protocol 1753881-1 on 7 November 2023).

Informed Consent Statement: All data collection and recruitment protocols were reviewed and approved by the Charles George VA Medical Center (IRB). All participants provided written informed consent.

Data Availability Statement: The datasets presented in this article are not readily available due to Federal Government restrictions. Requests to access the de-identified datasets should be directed to charles.mahan@va.gov.

Acknowledgments: The authors would like to thank the hospitalist and nursing staff of the Charles George VA Medical Center for their assistance in the recruitment of patients and clinical documentation, William S. Wamack and Samuel H. Burnette, who performed initial literature reviews, and the veterans who participated in this study.

Conflicts of Interest: The authors declare no conflicts of interest.

References

1. Raco, J.; Peterson, B.; Muallem, S. Assessment of Volume Status in Hospitalized Patients with Chronic Heart Failure. *Cardiol. Res.* **2023**, *14*, 2–11. [[CrossRef](#)] [[PubMed](#)]
2. Koratala, A.; Kazory, A. Natriuretic Peptides as Biomarkers for Congestive States: The Cardiorenal Divergence. *Dis. Markers* **2017**, *2017*, 1454986. [[CrossRef](#)] [[PubMed](#)]
3. Heidenreich, P.A.; Bozkurt, B.; Aguilar, D.; Allen, L.A.; Byun, J.J.; Colvin, M.M.; Deswal, A.; Drazner, M.H.; Dunlay, S.M.; Evers, L.R.; et al. 2022 AHA/ACC/HFSA Guideline for the Management of Heart Failure. *Circulation* **2022**, *145*, e895–e1032. [[PubMed](#)]
4. Volpicelli, G.; Caramello, V.; Cardinale, L.; Mussa, A.; Bar, F.; Frascisco, M.F. Bedside ultrasound of the lung for the monitoring of acute decompensated heart failure. *Am. J. Emerg. Med.* **2008**, *26*, 585–591. [[CrossRef](#)] [[PubMed](#)]
5. Goonewardena, S.N.; Gemignani, A.; Ronan, A.; Vasaiwala, S.; Blair, J.; Brennan, J.M.; Shah, D.P.; Spencer, K.T. Comparison of hand-carried ultrasound assessment of the inferior vena cava and N-terminal pro-BNP for predicting readmission after hospitalization for acute decompensated heart failure. *JACC Cardiovasc. Imaging* **2008**, *1*, 595–601. [[PubMed](#)]
6. Gargani, L.; Pang, P.S.; Frassi, F.; Miglioranza, M.H.; Dini, F.L.; Landi, P.; Picano, E. Persistent pulmonary congestion before discharge predicts rehospitalization in heart failure: A lung ultrasound study. *Cardiovasc. Ultrasound* **2015**, *13*, 40. [[CrossRef](#)] [[PubMed](#)]
7. Mozzini, C.; Di Dio Perna, M.; Pesce, G.; Garbin, U.; Fratta Pasini, A.M.; Ticinesi, A.; Nouvenne, A.; Meschi, T.; Casadei, A.; Soresi, M.; et al. Lung ultrasound in internal medicine efficiently drives the management of patients with heart failure and speeds up discharge time. *Intern. Emerg. Med.* **2018**, *13*, 27–33. [[CrossRef](#)] [[PubMed](#)]
8. Yampolsky, S.; Kwan, A.; Cheng, S.; Kedan, I. Point of care ultrasound for diagnosis and management in heart failure: A targeted literature review. *POCUS J.* **2024**, *9*, 117–129. [[CrossRef](#)] [[PubMed](#)]
9. Malagón, S.V.; Acosta-Gutiérrez, E.; Nuñezramos, J.A.; Salinas, S.; Pabón, G.M. Subclinical congestion evaluated by point-of-care ultrasound at discharge predicts readmission in acute heart failure. *POCUS J.* **2024**, *9*, 125–132. [[CrossRef](#)] [[PubMed](#)]
10. Platz, E.; Campbell, R.T.; Claggett, B.; Lewis, E.F.; Groarke, J.D.; Docherty, K.F.; Lee, M.M.Y.; Merz, A.A.; Silverman, M.; Swamy, V.; et al. Lung Ultrasound in Acute Heart Failure: Prevalence of Pulmonary Congestion and Short-and Long-Term Outcomes. *JACC Heart Fail.* **2019**, *7*, 849–858. [[CrossRef](#)] [[PubMed](#)] [[PubMed Central](#)]
11. Argaiz, E.R.; Koratala, A.; Reisinger, N. Comprehensive Assessment of Fluid Status by Point-of-Care Ultrasonography. *Kidney360* **2021**, *2*, 1326–1338. [[CrossRef](#)] [[PubMed](#)] [[PubMed Central](#)]
12. Mercaldo, N.D.; Lau, K.F.; Zhou, X.H. Confidence intervals for predictive values with an emphasis to case-control studies. *Stat. Med.* **2007**, *26*, 2170–2183. [[CrossRef](#)] [[PubMed](#)]
13. Pettit, N.A.; Pedroja, B.S.; Li, H.F.; Sutcliffe, M. Brief training in ultrasound equips novice clinicians to accurately and reliably measure jugular venous pressure in obese patients. *Australas. J. Ultrasound Med.* **2023**, *26*, 85–90. [[CrossRef](#)] [[PubMed](#)] [[PubMed Central](#)]
14. Saadi, M.P.; Machado, G.P.; Silvano, G.P.; Barbato, J.P.R.; Almeida, R.F.; Scolari, F.L.; Telo, G.H.; Silveira, A.D. Assessment of Interrater Reliability in Point-of-Care Ultrasound for Assessing Congestion in Cardiovascular Intensive Care. *Arq. Bras. Cardiol. Imagem Cardiovasc.* **2025**, *38*, e20250022.
15. Soni, N.J.; Schnobrich, D.; Mathews, B.K.; Tierney, D.M.; Jensen, T.P.; Dancel, R.; Cho, J.; Dversdal, R.K.; Mints, G.; Bhagra, A.; et al. Point-of-Care Ultrasound for Hospitalists: A Position Statement of the Society of Hospital Medicine. *J. Hosp. Med.* **2019**, *14*, E1–E6. [[CrossRef](#)] [[PubMed](#)] [[PubMed Central](#)]
16. Maganti, K.; Chen, C.; Jamthikar, A.D.; Parikh, P.; Yanamala, N.; Sengupta, P.P. Cardiopulmonary Point-of-Care Ultrasonography for Hospitalist Management of Undifferentiated Dyspnea. *JAMA Netw. Open* **2025**, *8*, e2530677. [[CrossRef](#)] [[PubMed](#)]

Disclaimer/Publisher’s Note: The statements, opinions and data contained in all publications are solely those of the individual author(s) and contributor(s) and not of MDPI and/or the editor(s). MDPI and/or the editor(s) disclaim responsibility for any injury to people or property resulting from any ideas, methods, instructions or products referred to in the content.