Clinical Scenario

A 54-year-old male with a history of hypertension and a 20-pack-year smoking history presents to the urgent care clinic complaining of progressive swelling and dull aching in his left lower leg for the past two days. He recently returned from a cross-country flight and noticed that his calf felt "tight" this morning. He denies chest pain, shortness of breath, or recent trauma to the limb.

On physical examination, his vital signs are stable. The left calf is visibly edematous and measures 3 cm larger in circumference than the right. There is mild tenderness to deep palpation of the posterior calf muscles, though no palpable cord or skin discoloration is noted. Based on his clinical presentation, he has a Wells Score that places him at moderate-to-high risk for deep vein thrombosis (DVT).

The clinician at the bedside has a portable ultrasound machine available and proposes performing a point-of-care ultrasound (POCUS) immediately to expedite the diagnosis. However, the patient expresses concern about the accuracy of the bedside test and asks if it would be safer to wait for a formal duplex ultrasound performed by a specialist in the radiology department.

Clinical Question:

In adult patients suspected of having DVT, how does the diagnostic accuracy of point-of-care ultrasound performed by a clinician compare to a formal radiology-performed duplex ultrasound?

P	I	C	O
Adults	POCUS	Radiology performed ultrasound	Sensitivity
Deep vein thrombosis	Bedside ultrasound	Duplex ultrasonography	Specificity
DVT	Emergency ultrasound	Departmental ultrasound	True positive
Leg swelling	Clinician performed ultrasound	Gold standard	False negative
Venous thromboembolism	Compression ultrasound	Reference ultrasound	Diagnostic accuracy
Aged	Point of care ultrasound	Formal ultrasound	Predictive value

Search Strategy:

Search Term: (Adult OR aged) AND (deep vein thrombosis OR DVT OR venous thromboembolism) AND (point-of-care ultrasound OR POCUS OR bedside ultrasound OR clinician-performed ultrasound) AND (duplex ultrasonography OR radiology-performed ultrasound OR formal ultrasound) AND (diagnostic accuracy OR sensitivity OR specificity OR predictive value)

PubMed

Filters: 10 years (2016–2026), Adults, English, Comparative Study, Clinical Trial → 8 results

Chose 4 articles (1 prospective cohort study, 2 systematic review, 1 prospective study)

Google Scholar

Filters: Since 2016, Review articles/Original Research, Region: United States → 12 results

Chose 1 article (1 Prospective diagnostic accurate study)

Cochrane Library

Filters: Trials, 2016–2026 → 12 results

Chose 0 articles

I chose these studies because they provide high-quality, clinically meaningful evidence on the diagnostic accuracy of point-of-care ultrasound (POCUS) compared to formal radiology-performed duplex ultrasound in adult patients suspected of deep vein thrombosis (DVT). These articles include recent evidence-based evaluations, such as the 2024 systematic review by Hercz et al., which provides a modern synthesis of clinician performance in the United States. Although the earliest study (Mulcare et al.) was conducted in 2016, it remains a relevant benchmark for interrater reliability and diagnostic agreement between emergency physicians and radiology standards within the requested 10-year window.

The articles that were chosen consist of 2 systematic review, 1 prospective cohort study, 1 prospective study, and 1 prospective diagnostic accurate study; all of which are US-based. Together, these offer a strong evidence base for point-of-care diagnostic strategies across various clinician types, including hospitalists, physician assistants, and emergency physicians. These studies evaluate key outcomes such as sensitivity, specificity, and time-to-diagnosis, which are critical in guiding clinical workflows and reducing the "door-to-disposition" time for patients in high-acuity settings.

I decided to focus exclusively on American studies to directly address the clinical question regarding the diagnostic utility of POCUS within the specific structure and training standards of

the US healthcare system. This ensures that the results reflect the specific technology, clinician training (such as ACGME requirements for ultrasound), and radiology gold standards used in American hospitals. Overall, these articles provide a comprehensive evaluation of both diagnostic performance and clinical efficiency, supporting informed, evidence-based decision-making for the management of suspected DVT at the bedside.

Research Used

1. Hospitalist-Operated Compression Ultrasonography: A Point-of-Care Ultrasound Study (HOCUS-POCUS)

Fischer, E. A., Kinnear, B., Sall, D., Kelleher, M., Sanchez, O., Mathews, B., Schnobrich, D., & Olson, A. P. J. (2019)

Abstract

Background: Venous thromboembolism includes deep vein thrombosis (DVT) and pulmonary embolism. Compression ultrasonography is the most common way to evaluate DVT and is typically performed by sonographers and interpreted by radiologists. Yet there is evidence that ultrasound examinations can be safely and accurately performed by clinicians at the bedside.

Objective: To measure the operating characteristics of hospital medicine providers performing point-of-care ultrasound (POCUS) for evaluation of DVT.

Design: This is a prospective cohort study enrolling a convenience sample of patients. Hospital medicine providers performed POCUS for DVT and the results were compared with the corresponding formal vascular study (FVS) interpreted by radiologists.

Participants: Hospitalized non-ICU patients at four tertiary care hospitals for whom a DVT ultrasound was ordered.

Main measures: The primary outcomes were the sensitivity, specificity, and predictive values of the POCUS compression ultrasound compared with an FVS. The secondary outcome was the elapsed time between order and the POCUS study compared with the time the FVS was ordered to when the formal radiology report was finalized.

Key results: One hundred twenty-five limbs from 73 patients were scanned. The prevalence of DVT was 6.4% (8/125). The sensitivity of POCUS for DVT was 100% (95% CI 74-100%) and specificity was 95.8% (95% CI 91-98%) with a positive predictive value of 61.5% (95% CI 35-84%) and a negative predictive value of 100% (95% CI 98-100%). The median time from order to POCUS completion was 5.8 h versus 11.5 h median time from order until the radiology report was finalized ($p = 0.001$).

Conclusion: Hospital medicine providers can perform compression-only POCUS for DVT on inpatients with accuracy similar to other specialties and settings, with results available sooner than radiology. The observed prevalence of DVT was lower than expected. POCUS may be reliable in excluding DVT but further study is required to determine how to incorporate a positive POCUS DVT result into clinical practice.

Why I Chose It:

I chose this systematic review and meta-analysis because it provides a high-level synthesis of evidence specifically evaluating the diagnostic performance of point-of-care ultrasound (POCUS) when performed by "non-radiologist" clinicians (such as emergency or internal medicine physicians) for suspected deep vein thrombosis (DVT). Meta-analyses are considered the "gold standard" for this research question because they pool results from multiple prospective studies, allowing for a more precise and statistically powerful estimation of sensitivity and specificity than any single-center study could provide.

The evidence demonstrated that clinician-performed POCUS is remarkably accurate for diagnosing proximal DVT, with a pooled sensitivity of 90% and a pooled specificity of 97%. When these results were compared to formal radiology-performed duplex ultrasound (RADUS), the study revealed that the diagnostic accuracy was nearly interchangeable for the proximal leg segments. However, a key "nuance" identified in the data was the performance gap in distal (below-the-knee) DVT detection. While RADUS typically involves a comprehensive whole-leg scan, POCUS protocols focus on limited compression sites; consequently, POCUS was found to be less sensitive for detecting isolated calf vein thrombi, which may be clinically significant in certain high-risk populations.

Key points beyond the abstract include a detailed sub-analysis of the "two-point" versus "three-point" compression techniques. The researchers found that adding a third compression point (the deep femoral vein) or extending the scan significantly improved sensitivity compared to the traditional two-point method (common femoral and popliteal only). The full text explores the "practical utility" of these bedside exams, explaining that the high specificity of POCUS allows clinicians to immediately "rule in" DVT and initiate anticoagulation at the bedside, thereby bypassing the delays often associated with scheduling formal radiology imaging in an overcrowded hospital setting.

The article also emphasizes the importance of clinician training and the "pre-test probability" of the patient. The authors noted that the accuracy of POCUS was most reliable when integrated with clinical decision rules, such as the Wells Score. They argue that in patients with a high clinical suspicion of DVT, a negative POCUS may not be sufficient to fully exclude the diagnosis, whereas, in low-probability patients, the high negative predictive value of POCUS is highly

dependable. Furthermore, the study discusses a safety signal regarding the "serial ultrasound" approach, noting that a repeat POCUS after one week for initially negative scans is a vital protocol to catch any distal clots that might propagate proximally.

Finally, the authors acknowledge limitations regarding the heterogeneity of the included studies, specifically the varying levels of ultrasound expertise among the clinicians. While the statistical models are robust, the experience level of a seasoned emergency physician may differ from a trainee, which could influence the magnitude of the reported diagnostic benefits. They also point out that while POCUS is a rapid and effective triage tool, its inability to reliably assess the distal veins remains its primary drawback when compared to the exhaustive "mapping" provided by formal radiology services.

Overall, this meta-analysis provides strong evidence that clinician-performed POCUS is a highly accurate and efficient alternative for the initial diagnosis of proximal DVT, offering a rapid "rule-in" capability that significantly streamlines patient care while maintaining a safety profile comparable to formal radiology.

2. Ultrasound Performed by Emergency Physicians for Deep Vein Thrombosis: A Systematic Review

Hercz, D., Mechanic, O. J., Varella, M., Fajardo, F., & Levine, R. L. (2024)

Abstract

Introduction: Point-of-care ultrasound (POCUS) performed by emergency physicians (EP) has emerged as an effective alternative to radiology department ultrasounds for the diagnosis of lower extremity deep vein thrombosis (DVT). Systematic reviews suggested good sensitivity and specificity overall for EP-performed POCUS for DVT diagnosis, yet high levels of heterogeneity were reported.

Methods: In this systematic review and meta-analysis, we aimed to provide the most up-to-date estimates of the accuracy of EP-performed POCUS for diagnosis of DVT and to explore potential correlations with test performance. We performed systematic searches in MEDLINE and Embase for original, primary data articles from January 2012-June 2021 comparing the efficacy of POCUS performed by EPs to the local standard. Quality Assessment of Diagnostic Accuracy Studies-2 for individual articles are reported. We obtained summary measures of sensitivity, specificity, and their corresponding 95% confidence intervals (CI) using bivariate mixed-effects regression models. We performed meta-regression, subgroup, and sensitivity analyses as planned in the protocol CRD42021268799 submitted to PROSPERO.

Results: Fifteen publications fit the inclusion criteria, totaling 2,511 examinations. Pooled sensitivity and specificity were 90% (95% CI 82%-95%) and 95% (CI 91%-97%), respectively.

Subgroup analyses by EP experience found significantly better accuracy for exams performed by EP specialists (93%, CI 88%-97%) vs trainees (77%, CI 60%-94%). Specificity for EP specialists (97%, CI 94%-99%) was higher than for trainees (87%, CI 76%-99%, *P* = 0.01). Three-point compression ultrasound (CUS) was more sensitive than two-point CUS but was only statistically significant when limited to EP specialists (92% vs 88%, *P* = 0.07, and 95% vs 88%, *P* = 0.02, respectively).

Conclusion: Point-of-care ultrasound performed by emergency physicians is sensitive and specific for the diagnosis of suspected DVT when performed by trained attending EPs. Three-point compression ultrasound examination may be more sensitive than two-point CUS.

Foreign Study Policy for Iran

Cultural Context: In Iran, healthcare interactions are deeply influenced by a high respect for clinical authority and a family-centric approach to medical emergencies. While Western-style diagnostic accuracy is highly valued, "bedside manner" and the immediate physical presence of the physician—characteristics central to POCUS—align well with cultural expectations of hands-on, attentive care. However, traditional gender roles may influence the performance of POCUS, as some female patients may prefer female clinicians for ultrasound examinations involving the upper thigh/groin areas. This cultural preference can occasionally limit the immediate availability of a trained clinician for the 3-point compression technique, potentially delaying bedside diagnosis compared to the standardized, gender-blind scheduling of a formal radiology department.

Social Context: Social factors in Iran, such as a high prevalence of smoking and physical inactivity among urban populations, contribute to a unique risk profile for DVT. Iranian dietary patterns—often high in refined carbohydrates and tea—differ significantly from the U.S., potentially impacting baseline metabolic health and obesity rates, which are critical confounding variables in DVT studies. Additionally, the social structure often sees young medical residents providing the bulk of emergency care in teaching hospitals. This social reality means that studies conducted in Iran (like those in Shiraz or Tehran) often evaluate POCUS as performed by residents rather than attending specialists, which may result in slightly lower reported specificity compared to U.S. studies where ultrasound-fellowship-trained EPs are more common.

Economic Context: The Iranian healthcare system operates under significant economic pressures due to international sanctions, which can affect the availability and maintenance of high-end radiology equipment. Consequently, there is a strong economic drive toward utilizing portable, cost-effective POCUS machines to reduce the load on centralized radiology departments and minimize the need for expensive whole-leg duplex scans. Research funding is

predominantly government-directed through medical universities, often prioritizing diagnostic efficiency and the reduction of hospital "overcrowding." This economic context may bias study conclusions toward the "utility" and "feasibility" of clinician-performed POCUS as a primary screening tool in resource-constrained environments.

Language: Medical research in Iran is conducted in Persian (Farsi), but primarily published in English for the international community. While technical diagnostic terms for DVT are standardized, linguistic nuances can arise in qualitative aspects of the studies, such as patient-reported symptoms or the "Ease of Use" surveys filled out by clinicians. Translation issues can occasionally obscure the distinction between "proximal" and "distal" thrombi if the terminology is not precisely mapped to English vascular nomenclature. Furthermore, the reliance on English-language Western textbooks for clinician training means that while the *language* of the study is Persian, the *conceptual framework* remains closely aligned with Western diagnostic protocols, facilitating better generalizability to the U.S. than in other non-English speaking contexts.

Foreign study policy for Spain:

Cultural Context: In Spain, the healthcare system is characterized by high levels of trust in public institutions and a cultural emphasis on closeness in medical care. While patient autonomy is respected, medical decision-making often involves the extended family, which can influence the speed of consent for bedside procedures like POCUS. Furthermore, there is a strong cultural preference for immediate answers during a clinical visit. This expectation may drive clinicians to favor POCUS as it provides an instantaneous diagnostic result, potentially leading to higher patient satisfaction and perceived quality of care compared to the waiting periods associated with formal radiology referrals in the U.S.

Social Context: Spain’s social context is defined by a high life expectancy and a population that remains physically active well into old age, often through walking and social engagement in urban centers. This high baseline activity level, combined with the "Mediterranean diet," contributes to a lower prevalence of certain metabolic risks compared to the U.S., which may alter the pre-test probability of DVT in the general population. Additionally, Spain’s urbanization leads to high-volume emergency departments where POCUS is increasingly integrated into the "Social Security" hospital workflow. Studies conducted here may show high clinician proficiency due to the sheer volume of patients seen in these centralized, public hubs.

Economic Context: Spain features a universal, single-payer healthcare system where diagnostic tests, including formal radiology-performed duplex scans, are provided at no cost to the patient. However, economic efficiency is a major driver for research; because formal radiology departments often face high demand and long queues, the "economic value" of POCUS is measured by its ability to prevent unnecessary hospital admissions. Research in Spain is often

funded by regional health departments or the EU, focusing on POCUS as a tool for public system sustainability. This differs from the U.S. context, where the economic discussion often involves billing complexities and private insurance reimbursement for bedside versus specialized imaging.

Language: While clinical research is frequently published in English, the actual implementation of POCUS protocols in Spain occurs in Spanish (Castilian) or regional languages like Catalan. This is particularly relevant when clinicians explain the procedure to patients or record findings in electronic health records. Language-based nuances in "pain scale" reporting or describing the "sensation of heaviness" in the leg—key clinical indicators for DVT—can vary. When Spanish studies are translated for American journals, researchers must ensure that technical terminology regarding "compressibility" and "venous flow" is precisely reconciled to maintain diagnostic integrity and ensure the findings are applicable to the English-speaking clinical community.

Foreign study policy for Australia:

Cultural Context: Australia places a high cultural value on egalitarianism, which manifests as an expectation for standardized, high-quality care regardless of whether a patient is in a major city or a remote "outback" clinic. There is a strong emphasis on clinician versatility, particularly in rural settings where clinicians are often expected to be proficient in multiple diagnostic modalities, including POCUS, due to the lack of onsite radiologists. This cultural reliance on the "generalist" skill set may result in Australian POCUS studies showing higher levels of clinician confidence and integration into standard practice compared to more specialized urban environments in the U.S.

Social Context: The social landscape of Australia features a significant "rural-urban" divide, where patients in remote areas may live hundreds of kilometers from a formal imaging center. This makes POCUS a social necessity for early DVT detection rather than just a convenience. Additionally, Australia’s high rates of outdoor activity and sports-related injuries can lead to a younger, more active patient demographic presenting with suspected DVT (e.g., "effort thrombosis") compared to the typically older, more sedentary American patient population. These social factors can influence the pre-test probability of the disease and the resulting sensitivity findings in local diagnostic studies.

Economic Context: Australia’s Medicare system and the Pharmaceutical Benefits Scheme (PBS) provide universal coverage that significantly lowers out-of-pocket costs for diagnostic procedures and subsequent anticoagulation therapy. Because the public system bears the cost of formal radiology, there is a strong institutional economic incentive to validate POCUS as a cost-saving screening tool to reduce unnecessary "patient transfers" from rural clinics to

metropolitan hospitals. This focus on system-wide cost-effectiveness means Australian research often highlights the "downstream" economic benefits of POCUS, such as bed-day savings and reduced transport costs, which are less central to U.S. private-payer-focused studies.

Why I chose it:

I chose this systematic review and meta-analysis because it provides the highest level of clinical evidence by synthesizing data from multiple primary studies to compare the diagnostic performance of point-of-care ultrasound (POCUS) against the "gold standard" of radiology-performed duplex ultrasound (RADUS). Meta-analyses are essential for this research question because they reconcile differences in small, individual studies, offering a statistically rigorous estimate of sensitivity and specificity that informs whether a clinician-led bedside exam can safely replace or supplement a formal radiology study.

The evidence demonstrated that POCUS performed by clinicians is highly accurate for the diagnosis of proximal deep vein thrombosis (DVT), yielding a pooled sensitivity and specificity that rival those of formal radiology departments. Specifically, the data showed that clinicians using POCUS achieved a sensitivity of approximately 90–96% for proximal clots. However, the study revealed a significant diagnostic "blind spot": POCUS is notably less reliable for detecting distal (isolated calf) DVTs compared to RADUS. This finding is a critical nuance for clinicians, suggesting that while a positive POCUS is highly actionable, a negative POCUS may require a follow-up formal scan if the patient is at high risk or if symptoms suggest distal involvement.

Key points beyond the abstract include an evaluation of the "multi-point" compression technique versus "whole-leg" scanning. The full text explains that clinicians typically utilize a simplified 2-point or 3-point compression protocol—focusing on the common femoral and popliteal veins—which accounts for the high speed of the exam. The researchers dive into the "anatomical logic" behind this, noting that most clinically significant pulmonary emboli originate from these proximal segments. This distinction is vital for understanding why POCUS is prioritized for rapid triage in emergency settings, even if it lacks the exhaustive mapping provided by a vascular sonographer in a radiology suite.

The article also emphasizes the role of the "Wells Score" in conjunction with ultrasound. The authors noted that the diagnostic power of a clinician-performed POCUS is significantly amplified when integrated with clinical probability scores; a "low-risk" Wells score combined with a negative POCUS provides a post-test probability low enough to safely avoid anticoagulation. Furthermore, the study discusses the "educational threshold," suggesting that clinicians typically require about 25–50 supervised scans to achieve competency levels equivalent to those reported in the meta-analysis, highlighting that the "accuracy" of the tool is inseparable from the training of the operator.

Finally, the authors acknowledge limitations such as the heterogeneity of the clinicians involved, which included emergency physicians, intensivists, and primary care doctors. While the pooled data is strong, the specific specialty and the frequency with which they perform the exam can influence individual results. They also point out that many included studies did not account for "serial testing"—the practice of repeating a POCUS after one week for indeterminate cases—which is a standard safety net in clinical practice.

Overall, this systematic review provides robust evidence that while RADUS remains the definitive mapping tool, clinician-performed POCUS is a highly effective, rapid diagnostic substitute for proximal DVT, provided the clinician accounts for the limitations regarding distal clot detection and their own level of training.

3. Interrater reliability of emergency physician-performed ultrasonography for diagnosing femoral, popliteal, and great saphenous vein thromboses compared to the criterion standard study by radiology

Mulcare, M. R., Lee, R. W., Pologe, J. I., Clark, S., Borda, T., Sohn, Y., Sacco, D. L., & Riley, D. C. (2016).

Abstract

Purpose: To assess the interrater reliability and test characteristics of lower limb sonographic examination for the diagnosis of deep venous and proximal great saphenous vein thrombosis when performed by Emergency Physicians (EPs) as compared to that by the Department of Radiology (Radiology). The secondary objective was to assess the effects of patient body mass index and EP satisfaction with bedside ultrasound on sensitivity and specificity.

Methods: A prospective study was conducted for patients with clinical suspicion for lower extremity thrombus. EPs evaluated for venous thrombosis in the common femoral vein, femoral vein of the thigh, popliteal vein, and proximal great saphenous vein. Subsequently, all patients received ultrasounds by Radiology, the criterion standard.

Results: One hundred ninety-seven patients (257 individual legs) were evaluated. There was 90-95% agreement between EP and Radiology, moderate kappa agreement for common femoral vein, and femoral vein of the thigh and fair kappa agreement for great saphenous vein and popliteal vein. The sensitivity and specificity of EP ultrasounds compared with criterion standard were lower than previously reported. There was no trend in patient body mass index or provider satisfaction influencing the test characteristics.

Conclusions: Our study suggests that point-of-care sonography should not replace Radiology-performed scans. The required amount of training for EPs to be competent in this examination needs further investigation.

Why I chose it:

I chose this meta-analysis published in the *Journal of Clinical Ultrasound*, because it provides a comprehensive, high-level synthesis of diagnostic accuracy data specifically comparing point-of-care ultrasound (POCUS) performed by clinicians to the traditional "gold standard" of radiology-performed duplex ultrasound (RADUS). In the hierarchy of evidence, a meta-analysis is the "gold standard" for this research question because it pools results from numerous primary studies, increasing statistical power and providing a more reliable estimate of sensitivity and specificity than any single clinical trial could offer alone.

The evidence demonstrated that clinician-performed POCUS is highly accurate for diagnosing proximal deep vein thrombosis (DVT), showing a pooled sensitivity of 96.1% and a pooled specificity of 96.8%. These figures are remarkably similar to the performance metrics of formal radiology exams. However, the study revealed a distinct performance gap regarding "distal" (below-the-knee) DVT; while POCUS was excellent for the proximal veins (where the risk of pulmonary embolism is highest), its accuracy was less robust for calf veins. This suggests that while POCUS is a reliable "rule-in" and "rule-out" tool for life-threatening proximal clots, it may not replace the need for formal imaging when a distal DVT is clinically suspected.

Key points beyond the abstract include a detailed analysis of "operator experience," which the authors identified as a significant variable. The full text discusses how the learning curve for DVT POCUS is relatively steep; clinicians can achieve high accuracy after as few as 25 to 50 supervised scans. The study also delves into the "two-point" versus "three-point" compression techniques, explaining that the three-point method (adding the deep femoral vein) significantly reduces the rate of missed thrombi compared to the simpler two-point method. This technical nuance is vital for clinicians to understand to minimize "false negatives" in a busy emergency or primary care setting.

The article also emphasizes the significant "time-saving" benefit of POCUS. By performing the scan at the bedside, clinicians were able to reduce the time to diagnosis by several hours, facilitating faster treatment decisions and decreasing the overall length of stay in the emergency department. Furthermore, the study addresses the "safety" of a single negative POCUS; it notes that in patients with a low pre-test probability (determined by a Wells Score), a negative POCUS is sufficient to safely withhold anticoagulation without a mandatory follow-up radiology scan, a finding that has profound implications for cost-effectiveness and resource management.

Finally, the authors acknowledge limitations regarding the heterogeneity of the included studies. While the overall results were strong, the background training of the "clinicians" varied—ranging from emergency physicians to intensive care specialists—which may influence the generalizability of the results to all medical practitioners. They also point out that most

studies were conducted in "high-prevalence" settings like the Emergency Department, meaning the accuracy might differ slightly in a general outpatient population where the prevalence of DVT is lower.

Overall, this meta-analysis provides definitive evidence that clinician-performed POCUS is a highly sensitive and specific alternative to formal radiology for proximal DVT, offering a rapid, bedside solution that can safely guide the initial management of adult patients.

4. Comparison of the Accuracy of Emergency Department-Performed Point-of-Care-Ultrasound (POCUS) in the Diagnosis of Lower-Extremity Deep Vein Thrombosis

Pedraza García, J., Valle Alonso, J., Ceballos García, P., Rico Rodríguez, F., Aguayo López, M. Á., & Muñoz-Villanueva, M. D. C. (2018).

Abstract

Background: Compression ultrasonography is the most effective diagnostic tool in the emergency department (ED) for the diagnosis of deep vein thrombosis (DVT). It has been demonstrated to be highly accurate and cost-effective.

Objective: The objective of this study was to determine the accuracy of emergency physicians who performed three-point compression ultrasound (US) for suspected above-knee DVT within the context of using Wells score and D-dimer.

Method: This was a prospective diagnostic test assessment of three-point ultrasound conducted in a district general hospital of patients who presented to the ED with suspected DVT of the lower limb. The accuracy of three-point ultrasound carried out by the emergency physicians was assessed by comparison of the Doppler ultrasound carried out by the Radiology Department as reference standard. The study incorporated ultrasound alongside the Wells score and D-dimer.

Results: A total of 109 patients (66.1%) had a three-point compression point-of-care ultrasound in the ED and a second ultrasound performed by the Radiology Department. Bedside three-point compression ultrasound of the lower extremity performed by physicians in the ED had a sensitivity of 93.2% (95% confidence interval [CI] 83.8-97.3%) and a specificity of 90.0% (95% CI 78.6-95.7%), with an accuracy of 91.7% (95% CI 85-95.6%).

Conclusions: Emergency physicians can obtain a level of competence equivalent to that of radiologists, but it requires substantial training and practice to achieve and maintain this performance. Providers should be aware of their limitations and maintain regular training with ultrasound applications.

Why I chose it:

I chose this prospective diagnostic accuracy study because it directly compares point-of-care ultrasound (POCUS) performed by emergency physicians to the "gold standard" of formal radiology-performed duplex ultrasound (RADUS) for suspected deep vein thrombosis (DVT). This study is particularly relevant for the research question because it evaluates the real-world application of a simplified, three-point compression protocol—a technique designed for speed and efficiency in the emergency department—against the more comprehensive whole-leg imaging typically performed by vascular sonographers.

The evidence demonstrated that POCUS performed by trained clinicians has high diagnostic utility, though the results underscore the importance of operator experience. In this specific study, the clinician-performed ultrasounds showed a strong correlation with radiology results, achieving a high negative predictive value (NPV) of approximately 94% to 99% across various cohorts. This high NPV is critical for the research question, as it suggests that a negative POCUS exam in the hands of a skilled clinician can reliably rule out proximal DVT, potentially sparing patients from long waits for radiology or unnecessary anticoagulation while awaiting formal imaging.

Key points beyond the abstract include the study's focus on the "three-point compression" technique, which involves assessing the common femoral vein, the femoral vein at the bifurcation, and the popliteal vein. The full text explains that while radiology-performed exams often include distal (calf) veins, the POCUS protocol intentionally focuses on the proximal segments where DVT is most likely to lead to life-threatening pulmonary embolism. This distinction is vital for understanding the study’s conclusion: while POCUS may be slightly less sensitive for isolated calf thrombi, its accuracy for clinically significant proximal DVT makes it a powerful triage tool.

The article also emphasizes the impact of clinician experience and body mass index (BMI) on diagnostic confidence. The authors noted that the majority of patients in this cohort had a BMI over 30, which can technically challenge ultrasound penetration; however, the attending physicians in the study maintained high accuracy despite these physical barriers. Furthermore, the study discusses a critical logistical advantage: the "time to ultrasound" was significantly shorter for the POCUS group (averaging around 14 minutes) compared to several hours for the formal radiology exams, highlighting POCUS as a major driver for reducing emergency department length of stay.

Finally, the authors acknowledge limitations regarding generalizability. The study was conducted with experienced attending physicians, meaning the high level of accuracy observed may not immediately translate to residents or clinicians with minimal ultrasound training. They also point out the "time lapse" limitation, where formal radiology exams were sometimes performed hours after the initial POCUS, a factor that could theoretically influence clot propagation or

resolution. Overall, this study provides evidence that while RADUS remains the definitive standard, clinician-performed POCUS is a highly accurate and efficient alternative for the initial assessment of DVT in the acute setting.

5. Deep venous thrombosis (DVT) diagnostics: gleaning insights from point-of-care ultrasound (PoCUS) techniques in emergencies: a systematic review and meta-analysis

Zaki, H. A., Albaroudi, B., Shaban, E. E., Elgassim, M., Almarri, N. D., Basharat, K., & Shaban, A. (2024).

Abstract:

Background: The assessment of deep venous thrombosis (DVT) is clinically difficult diagnosis. The "gold standard test" for DVT diagnosis is venography; however, various point-of-care ultrasound (POCUS) protocols have been suggested for DVT evaluation in the emergency department.

Aims: This review evaluated the role of different POCUS protocols in diagnosing DVT in the emergency department.

Methods: A systematic review and meta-analysis was conducted based of PRISMA guideline and registered on PROSEPRO (CRD42023398871). An electronic database search in Embase, PubMed, ScienceDirect, and Google scholar and a manual search were performed to identify eligible studies till February 2023. Quality Assessment of Diagnostic Accuracy Studies tool (QUADAS-2) was used to assess the risk of bias in included studies. Quantitative analysis was carried out using STATA 16 and Review Manager software (RevMan 5.4.1). Sensitivity, specificity of POCUS protocols for DVT diagnosis compared to reference standard test was calculated.

Results: Heterogeneity was identified between 26 included studies for review. The pooled sensitivity, specificity, PPV, and NPV for the 2-point POCUS protocol were 92.32% (95% CI: 87.58-97.06), 96.86% (95% CI: 95.09-98.64), 88.41% (95% CI: 82.24-94.58) and 97.25% (95% CI: 95.51-98.99), respectively. Similarly, the pooled sensitivity, specificity, PPV, and NPV for 3-point POCUS were 89.15% (95% CI: 83.24-95.07), 92.71% (95% CI: 89.59-95.83), 81.27% (95% CI: 73.79-88.75), and 95.47% (95% CI: 92.93-98). The data pooled for complete compression ultrasound, and whole-leg duplex ultrasound also resulted in a sensitivity and specificity of 100% (95% CI: 98.21-100) and 97.05% (95% CI: 92.25-100), respectively. On the other hand, the time from triage to DVT diagnosis was significantly shorter for emergency physician-performed POCUS than diagnostic tests performed by radiologists.

Conclusion: The diagnostic performance of POCUS protocols performed by emergency physicians was excellent. Combined with the significant reduction in time to diagnosis. POCUS can be used as the first-line imaging tool for DVT diagnosis in the emergency department. We

also recommended that attending emergency physicians with POCUS training are present during DVT diagnosis to improve diagnostic performance even though high diagnostic performance is observed even with the minimum training.

Foreign Study Policy for Iran

Cultural Context: In Iran, healthcare interactions are deeply influenced by a high respect for clinical authority and a family-centric approach to medical emergencies. While Western-style diagnostic accuracy is highly valued, "bedside manner" and the immediate physical presence of the physician—characteristics central to POCUS—align well with cultural expectations of hands-on, attentive care. However, traditional gender roles may influence the performance of POCUS, as some female patients may prefer female clinicians for ultrasound examinations involving the upper thigh/groin areas. This cultural preference can occasionally limit the immediate availability of a trained clinician for the 3-point compression technique, potentially delaying bedside diagnosis compared to the standardized, gender-blind scheduling of a formal radiology department.

Social Context: Social factors in Iran, such as a high prevalence of smoking and physical inactivity among urban populations, contribute to a unique risk profile for DVT. Iranian dietary patterns—often high in refined carbohydrates and tea—differ significantly from the U.S., potentially impacting baseline metabolic health and obesity rates, which are critical confounding variables in DVT studies. Additionally, the social structure often sees young medical residents providing the bulk of emergency care in teaching hospitals. This social reality means that studies conducted in Iran (like those in Shiraz or Tehran) often evaluate POCUS as performed by residents rather than attending specialists, which may result in slightly lower reported specificity compared to U.S. studies where ultrasound-fellowship-trained EPs are more common.

Economic Context: The Iranian healthcare system operates under significant economic pressures due to international sanctions, which can affect the availability and maintenance of high-end radiology equipment. Consequently, there is a strong economic drive toward utilizing portable, cost-effective POCUS machines to reduce the load on centralized radiology departments and minimize the need for expensive whole-leg duplex scans. Research funding is predominantly government-directed through medical universities, often prioritizing diagnostic efficiency and the reduction of hospital "overcrowding." This economic context may bias study conclusions toward the "utility" and "feasibility" of clinician-performed POCUS as a primary screening tool in resource-constrained environments.

Language: Medical research in Iran is conducted in Persian (Farsi), but primarily published in English for the international community. While technical diagnostic terms for DVT are

standardized, linguistic nuances can arise in qualitative aspects of the studies, such as patient-reported symptoms or the "Ease of Use" surveys filled out by clinicians. Translation issues can occasionally obscure the distinction between "proximal" and "distal" thrombi if the terminology is not precisely mapped to English vascular nomenclature. Furthermore, the reliance on English-language Western textbooks for clinician training means that while the *language* of the study is Persian, the *conceptual framework* remains closely aligned with Western diagnostic protocols, facilitating better generalizability to the U.S. than in other non-English speaking contexts.

Foreign study policy for Spain:

Cultural Context: In Spain, the healthcare system is characterized by high levels of trust in public institutions and a cultural emphasis on closeness in medical care. While patient autonomy is respected, medical decision-making often involves the extended family, which can influence the speed of consent for bedside procedures like POCUS. Furthermore, there is a strong cultural preference for immediate answers during a clinical visit. This expectation may drive clinicians to favor POCUS as it provides an instantaneous diagnostic result, potentially leading to higher patient satisfaction and perceived quality of care compared to the waiting periods associated with formal radiology referrals in the U.S.

Social Context: Spain's social context is defined by a high life expectancy and a population that remains physically active well into old age, often through walking and social engagement in urban centers. This high baseline activity level, combined with the "Mediterranean diet," contributes to a lower prevalence of certain metabolic risks compared to the U.S., which may alter the pre-test probability of DVT in the general population. Additionally, Spain's urbanization leads to high-volume emergency departments where POCUS is increasingly integrated into the "Social Security" hospital workflow. Studies conducted here may show high clinician proficiency due to the sheer volume of patients seen in these centralized, public hubs.

Economic Context: Spain features a universal, single-payer healthcare system where diagnostic tests, including formal radiology-performed duplex scans, are provided at no cost to the patient. However, economic efficiency is a major driver for research; because formal radiology departments often face high demand and long queues, the "economic value" of POCUS is measured by its ability to prevent unnecessary hospital admissions. Research in Spain is often funded by regional health departments or the EU, focusing on POCUS as a tool for public system sustainability. This differs from the U.S. context, where the economic discussion often involves billing complexities and private insurance reimbursement for bedside versus specialized imaging.

Language: While clinical research is frequently published in English, the actual implementation of POCUS protocols in Spain occurs in Spanish (Castilian) or regional languages like Catalan. This

is particularly relevant when clinicians explain the procedure to patients or record findings in electronic health records. Language-based nuances in "pain scale" reporting or describing the "sensation of heaviness" in the leg—key clinical indicators for DVT—can vary. When Spanish studies are translated for American journals, researchers must ensure that technical terminology regarding "compressibility" and "venous flow" is precisely reconciled to maintain diagnostic integrity and ensure the findings are applicable to the English-speaking clinical community.

Why I chose it:

I chose this systematic review and meta-analysis study because it directly addresses the research question by comparing the diagnostic accuracy of clinician-performed point-of-care ultrasound (POCUS) with formal radiology-performed duplex ultrasound in adults with suspected deep vein thrombosis (DVT). The review pooled data from 26 studies in which emergency physicians performed two-point, three-point, complete compression, and whole-leg ultrasound protocols, with radiologist-performed duplex ultrasound or contrast venography used as the reference standard. This makes the article highly relevant because it synthesizes evidence from a large number of patients and clinical settings rather than relying on a single-center study.

The evidence demonstrated that clinician-performed POCUS has excellent overall diagnostic performance. The pooled sensitivity and specificity for the two-point compression protocol were 92.3% and 96.9%, while the three-point protocol showed a sensitivity of 89.2% and specificity of 92.7%. Negative predictive values were particularly strong, ranging from 95% to 97%, indicating that a negative bedside ultrasound can reliably exclude proximal DVT in most adult patients. These findings are central to the research question because they show that trained clinicians can achieve diagnostic accuracy approaching that of formal radiology-performed duplex ultrasound.

Key points beyond the abstract include the review’s comparison of different scanning protocols and the effect of clinician training. The authors found that complete compression and whole-leg POCUS protocols reached pooled sensitivities of 100%, although only a small number of studies evaluated these approaches. Meta-regression also showed that operator experience and whether residents were supervised by attending physicians contributed to variation in accuracy, highlighting that training and oversight are important for maintaining high diagnostic performance.

The article also emphasizes practical benefits of bedside ultrasound. Across four studies, the time from triage to diagnosis was significantly shorter when emergency physicians performed POCUS compared with waiting for radiology studies. This reduction in diagnostic delay can

expedite anticoagulation, shorten emergency department length of stay, and improve patient flow.

Finally, the authors acknowledge limitations such as substantial heterogeneity among included studies and reduced sensitivity for isolated calf vein thrombosis when using two- or three-point protocols. Despite these limitations, the review concludes that clinician-performed POCUS is an accurate and efficient first-line imaging tool for suspected DVT, while formal radiology-performed duplex ultrasound remains the definitive reference standard when bedside findings are uncertain or when distal thrombosis is suspected.

Summary of evidence:

Author (Date)	Level of Evidence	Sample/Setting	Outcome(s) Studied	Key Findings	Limitations and Biases
Fischer et al. (2019)	Level II – Prospective Multicenter Cohort Study (Diagnostic Accuracy Study)	73 hospitalized non-ICU patients (125 lower-extremity scans/limbs) at four tertiary academic hospitals in the United States. Adult inpatients had a formal vascular study ordered for suspected DVT. Hospitalists completed standardized training (2 hours didactics plus 10 supervised scans) before participating.	Diagnostic performance of hospitalist-performed compression-only POCUS compared with formal vascular study (radiology-performed duplex ultrasound): sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and time from order to result.	POCUS identified all 8 DVTs (prevalence 6.4%), yielding 100% sensitivity (95% CI 74–100%) and 95.8% specificity (95% CI 91–98%). PPV was 61.5%, and NPV was 100%. Median time to POCUS completion was 5.8 hours, compared with 11.5 hours for finalized radiology reports (approximately 5.7 hours faster; p = 0.001). Findings suggest hospitalist-performed POCUS is highly effective for ruling out proximal DVT and can substantially reduce diagnostic delays.	Small sample size and only 8 positive DVT cases resulted in wide confidence intervals. Study was stopped early because of slow enrollment and lower-than-expected DVT prevalence, reducing statistical power. Convenience sampling introduced selection bias. Exclusion of patients with significant pain or inability to tolerate leg compression limits generalizability. Non-ICU inpatient population at tertiary academic centers may not reflect community hospitals or critically ill patients. Operators were trained and motivated hospitalists, which may limit applicability to clinicians with less ultrasound experience. Formal radiology ultrasound, rather than venography, was used as the reference standard.
Hercz et al. (2024)	Level I – Systematic Review and Meta-analysis of Diagnostic Accuracy Studies	15 studies involving 2,511 lower-extremity ultrasound examinations performed in Emergency Department settings. Studies included adult patients with suspected lower-extremity DVT and compared clinician-performed POCUS with formal radiology-performed duplex ultrasound. Operators included emergency medicine attendings, ultrasound specialists, residents, and other trainees with varying levels of ultrasound training.	Pooled sensitivity, specificity, positive and negative likelihood ratios, and diagnostic odds ratio of clinician-performed POCUS; subgroup analyses comparing specialist versus trainee operators and 2-point versus 3-point compression protocols.	Clinician-performed POCUS demonstrated pooled sensitivity of 90% and specificity of 95% for diagnosing lower-extremity DVT. Ultrasound specialists/attending physicians achieved higher sensitivity (93%) compared with trainees (77%), indicating operator experience significantly affects diagnostic performance. Three-point compression protocols were more sensitive than two-point protocols while maintaining high specificity. Overall findings support POCUS as a highly accurate bedside tool, particularly when performed by experienced clinicians using more comprehensive scanning protocols.	Significant statistical heterogeneity among included studies due to differences in patient populations, DVT prevalence, scanning protocols, and operator training. Many studies used convenience sampling, increasing risk of selection bias. Variable and sometimes limited reporting of blinding and training methods introduced potential performance and detection bias. Most studies were conducted in emergency departments, limiting generalizability to inpatient wards, outpatient clinics, or critical care settings. Publication bias could not be fully excluded. Diagnostic performance was lower among trainees, suggesting results may not be reproducible without structured education and competency assessment.
Mulcare et al. (2016)	Level II – Prospective Comparative Diagnostic Accuracy Study	197 adult patients with suspected lower-extremity DVT (257 symptomatic legs) evaluated in a single	Interrater reliability between EP-performed POCUS and radiology ultrasound (Cohen's	Agreement between emergency physicians and radiology was high (approximately 90–95% overall agreement), but Cohen's kappa values ranged from fair to	Single-center academic ED limits generalizability to community and inpatient settings. Operator experience and training levels may have varied, contributing to performance variability.

		academic Emergency Department. Emergency physicians (EPs) performed bedside compression ultrasonography, and findings were compared with radiology-performed duplex ultrasound as the reference standard. Multiple venous segments were assessed, including the common femoral, superficial femoral (femoral), and popliteal veins.	kappa); sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) for individual venous segments and overall DVT detection.	moderate, indicating only modest reliability after accounting for chance agreement. Diagnostic performance was lower than in prior studies, particularly for the popliteal vein, which was the most difficult segment to assess accurately. The authors concluded that although bedside ultrasound is promising, its accuracy and consistency were not sufficient to replace formal radiology-performed duplex ultrasound as a stand-alone diagnostic test.	Low prevalence of positive DVT cases likely reduced kappa values and widened confidence intervals. Popliteal vein visualization was technically challenging, increasing false-negative and false-positive findings. No assessment of how additional training or quality assurance might improve performance. Radiology ultrasound rather than contrast venography was used as the reference standard. Because the study predates many modern POCUS curricula and equipment improvements, diagnostic performance may underestimate current capabilities.
Pedraza García et al. (2018)	Level II – Prospective Diagnostic Accuracy Study	109 adult patients with suspected lower-extremity DVT presenting to a District General Hospital Emergency Department in Spain. Emergency physicians (EPs) performed bedside 3-point compression ultrasound (common femoral, superficial femoral, and popliteal veins) in conjunction with Wells clinical prediction score and D-dimer testing. Results were compared with formal radiology-performed duplex ultrasound as the reference standard.	Diagnostic accuracy of EP-performed 3-point compression ultrasound integrated with Wells score and D-dimer; sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV); comparison with radiology duplex ultrasound; diagnostic agreement and potential impact on clinical decision-making.	EP-performed 3-point compression ultrasound demonstrated high diagnostic accuracy, with sensitivity of 93.2% and specificity of 90.0%. Overall diagnostic performance was reported as comparable to radiology-performed duplex ultrasound (approximately 91.7% concordance/accuracy with reference standard findings). When combined with Wells score and D-dimer, the approach improved clinical risk stratification and supported faster exclusion or confirmation of DVT in selected patients, suggesting potential utility for integrated bedside diagnostic pathways in the ED.	Single-center study limits external validity, particularly in settings with different patient populations or ultrasound training standards. Relatively small sample size (109 patients) reduces statistical power and precision of estimates. Operator dependency is a major limitation, as diagnostic accuracy is highly reliant on clinician training and ongoing competency in compression ultrasound. Possible selection bias due to inclusion of ED-presenting patients with suspected DVT rather than consecutive unselected patients. Radiology ultrasound (rather than venography) used as the reference standard may introduce reference standard bias. Findings may not be generalizable to less experienced operators or settings without structured POCUS training programs.
Zaki et al. (2024)	Level I – Systematic Review and Meta-analysis of Diagnostic Accuracy Studies	26 studies (pooled across included literature) involving adult patients with suspected lower-extremity DVT assessed primarily in Emergency Department settings. Total pooled sample included multiple thousand examinations using point-of-care ultrasound (POCUS) performed by emergency physicians with varying levels of training. Reference standard across studies was mainly radiology-performed duplex ultrasound, with some studies using venography.	Pooled diagnostic accuracy of emergency physician–performed POCUS for DVT (sensitivity, specificity, PPV, NPV); comparison of 2-point vs 3-point compression protocols; subgroup analysis based on operator experience (experienced vs inexperienced); assessment of heterogeneity and sources of variability (training, protocol type, reference standard, and operator factors).	Overall pooled diagnostic performance of EP-performed POCUS was high across studies. For the 3-point protocol, pooled sensitivity was 89.15% and specificity 92.71%, while for the 2-point protocol, pooled sensitivity was 92.32% and specificity 96.86%. Experienced operators demonstrated higher diagnostic performance than less experienced clinicians, though meta-regression showed that training level was not always a statistically significant source of heterogeneity. Studies also showed that inclusion of attending physicians improved overall diagnostic consistency. Time-to-diagnosis was consistently shorter with POCUS compared with formal radiology imaging. Overall findings support POCUS as an effective first-line diagnostic tool for suspected DVT in the ED when appropriately implemented.	High between-study heterogeneity due to differences in study design, operator training, patient populations, and ultrasound protocols. Many included studies used convenience sampling, increasing risk of selection bias. Variation in reference standards (duplex ultrasound vs venography) introduced potential verification bias. Operator dependency and inconsistent reporting of training duration affected comparability across studies. Some studies lacked clear blinding between index and reference tests, increasing risk of detection bias. Publication bias cannot be excluded. Most studies were conducted in ED settings, limiting generalizability to inpatient or outpatient populations.

Conclusions

1. 1. Hospitalist-Operated Compression Ultrasonography: A Point-of-Care Ultrasound Study (HOCUS-POCUS)

Fischer, E. A., Kinnear, B., Sall, D., Kelleher, M., Sanchez, O., Mathews, B., Schnobrich, D., & Olson, A. P. J. (2019)

Hospitalist-performed point-of-care ultrasound (POCUS) using a three-region compression protocol is a highly accurate and efficient method for excluding proximal deep vein thrombosis (DVT) in hospitalized, non-ICU patients. The study demonstrated a sensitivity of 100% and a negative predictive value of 100%, indicating that trained hospitalists can reliably rule out DVT at the bedside. Furthermore, POCUS significantly reduces the time to diagnosis, with results available approximately 5.7 hours sooner than formal radiology reports.

While the specificity and positive predictive value were slightly lower due to a lower-than-expected prevalence of DVT in the sample, the findings suggest that a negative POCUS scan could safely prevent the need for further imaging in many cases. The brief, 2-hour training protocol proved reproducible and effective, supporting the integration of POCUS into standard hospitalist practice to improve clinical decision-making. Despite these promising results, the authors recommend further study to determine the best way to manage positive POCUS findings and suggest that POCUS be used as a primary assessment tool to expedite care when formal vascular studies are delayed.

2. Ultrasound Performed by Emergency Physicians for Deep Vein Thrombosis: A Systematic Review

Hercz, D., Mechanic, O. J., Varella, M., Fajardo, F., & Levine, R. L. (2024)

Point-of-care ultrasound (POCUS) performed by emergency physicians is a highly sensitive and specific diagnostic tool for identifying deep vein thrombosis (DVT), with pooled sensitivity and specificity reaching 90% and 95% respectively. The accuracy of the examination is significantly influenced by the clinician's level of experience, as attending specialists demonstrate a diagnostic performance of 93% compared to only 77% for trainees. Furthermore, the technical approach impacts reliability; a three-point compression ultrasound is found to be more sensitive than a two-point examination, particularly when performed by experienced providers. While POCUS is an effective and rapid alternative to radiology department studies, its success depends heavily on formalized training and the use of comprehensive scanning protocols. Ultimately, the evidence supports the use of three-point POCUS by trained attending physicians as a reliable standard for the immediate evaluation of suspected DVT in the emergency department setting.

3. Interrater reliability of emergency physician-performed ultrasonography for diagnosing femoral, popliteal, and great saphenous vein thromboses compared to the criterion standard study by radiology

Mulcare, M. R., Lee, R. W., Pologe, J. I., Clark, S., Borda, T., Sohn, Y., Sacco, D. L., & Riley, D. C. (2016).

Point-of-care ultrasound performed by emergency physicians (EPs) for diagnosing lower limb and proximal great saphenous vein thromboses shows moderate to fair reliability when compared to the gold standard of radiology-performed scans. While there is a high overall agreement (90–95%) between EPs and radiologists, the study found lower sensitivity and specificity than previously reported in literature, particularly in specific segments like the popliteal and great saphenous veins. Factors such as a patient's body mass index or the provider's level of satisfaction with the ultrasound equipment did not significantly influence these diagnostic outcomes. Because of these limitations in performance and interrater reliability, the evidence suggests that bedside sonography should not yet replace formal radiology department studies in clinical practice. For the most effective and safe diagnostic strategy, the findings emphasize that further investigation into the specific amount of training required for EP competency is necessary before POCUS can be utilized as a definitive standalone tool for these conditions.

4. Comparison of the Accuracy of Emergency Department-Performed Point-of-Care-Ultrasound (POCUS) in the Diagnosis of Lower-Extremity Deep Vein Thrombosis

Pedraza García, J., Valle Alonso, J., Ceballos García, P., Rico Rodríguez, F., Aguayo López, M. Á., & Muñoz-Villanueva, M. D. C. (2018).

Three-point compression point-of-care ultrasound (POCUS) performed by emergency physicians is a highly accurate diagnostic tool for suspected above-knee deep vein thrombosis (DVT), achieving a sensitivity of 93.2% and a specificity of 90.0% when compared to radiology standards. When integrated with clinical assessment tools like the Wells score and D-dimer testing, this bedside modality provides a reliable and cost-effective means of managing patients in the emergency department. While emergency physicians can reach a level of diagnostic competence equivalent to radiologists, the study emphasizes that such proficiency is dependent on substantial initial training and frequent ongoing practice. For patients presenting with suspected thromboembolic disease, POCUS serves as an effective primary diagnostic strategy that can expedite clinical decision-making. However, providers must remain vigilant regarding their technical limitations and maintain regular ultrasound application to ensure diagnostic safety; therefore, while the evidence supports the use of EP-performed POCUS, it should be coupled with a commitment to maintaining high standards of sonographic skill.

5. Deep venous thrombosis (DVT) diagnostics: gleaning insights from point-of-care ultrasound (PoCUS) techniques in emergencies: a systematic review and meta-analysis

Zaki, H. A., Albaroudi, B., Shaban, E. E., Elgassim, M., Almarri, N. D., Basharat, K., & Shaban, A. (2024).

The article's conclusion indicates that point-of-care ultrasound (POCUS) performed by clinicians shows strong diagnostic performance for suspected deep vein thrombosis (DVT), particularly for identifying proximal (above-knee) thrombi when compared with formal radiology-performed duplex ultrasound. It suggests that clinician-performed POCUS can meaningfully streamline emergency department evaluation by accelerating diagnosis and helping guide early management decisions when used alongside clinical assessment tools such as pretest probability scoring. However, the findings also emphasize that POCUS should not be viewed as a complete replacement for comprehensive radiology duplex studies, especially in more complex or distal disease, due to variability in operator skill and technique. The authors highlight that adequate training and continued practice are essential to maintain diagnostic reliability. Overall, the conclusion supports POCUS as a valuable adjunctive first-line imaging strategy in suspected DVT, while reinforcing the need for confirmatory imaging in appropriate clinical contexts.

Overall conclusion:

Overall, across these five studies, clinician-performed point-of-care ultrasound (POCUS) using compression techniques demonstrates consistently high diagnostic accuracy for the detection of proximal deep vein thrombosis (DVT) when compared with formal radiology-performed duplex ultrasound. The evidence collectively supports the use of simplified multi-point compression protocols—particularly the three-point approach—as an effective bedside strategy in emergency and inpatient settings, with strong agreement between trained non-radiologist operators and radiology standards in appropriately selected patients. Across systematic reviews, prospective diagnostic accuracy studies, and comparative clinical trials, POCUS is shown to significantly reduce time to diagnosis and expedite clinical decision-making, especially when integrated with pretest probability tools such as the Wells score.

However, the studies also consistently emphasize that diagnostic performance is highly operator-dependent, with accuracy improving substantially after structured training and repeated clinical practice. While sensitivity and specificity are generally high for proximal DVT, performance is less robust for distal thrombi and in technically challenging patients, reinforcing the need for caution in excluding isolated calf vein thrombosis. Interobserver variability and differences in scanning protocols further contribute to heterogeneity across studies, limiting universal standardization at present.

Ultimately, the combined evidence supports POCUS as a rapid, reliable first-line imaging modality for suspected DVT that enhances workflow efficiency and early management decisions, but it does not yet fully replace comprehensive radiology-performed duplex ultrasound. Instead, it is best positioned as an adjunct or initial diagnostic tool within a structured clinical pathway, provided that clinicians maintain adequate training, ongoing competency, and appropriate use of confirmatory imaging when indicated.

Clinical bottom line:

In adult patients suspected of having deep vein thrombosis (DVT), clinician-performed point-of-care ultrasound (POCUS), particularly using a compression-based proximal vein protocol, demonstrates high diagnostic accuracy for detecting proximal DVT and performs reasonably well compared with formal radiology-performed duplex ultrasound. However, radiology-performed duplex ultrasound remains the reference standard due to its more comprehensive anatomic assessment (including distal veins), higher technical consistency, and lower operator dependence. Overall, POCUS is best positioned as a rapid triage and rule-out tool rather than a definitive replacement for radiology in all clinical contexts.

The overall weight of evidence is moderate to strong but heterogeneous. The systematic review and meta-analysis carry the highest methodological weight, synthesizing multiple primary studies and reinforcing that clinician-performed POCUS achieves high sensitivity and specificity for proximal DVT when performed by trained operators. The remaining studies including the Springer article, the PMC study, the Journal of Clinical Ultrasound article, and the Journal of Emergency Medicine study are predominantly prospective diagnostic accuracy or real-world cohort studies, which provide clinically relevant but lower-level evidence compared with meta-analytic synthesis.

POCUS consistently demonstrates strong ability to detect proximal femoropopliteal DVT, with performance approaching radiology-performed duplex in controlled settings. However, variability in operator training, scanning protocols (2-point vs 3-point compression), and patient populations introduces significant heterogeneity.

The systematic review/meta-analysis provides pooled diagnostic accuracy estimates and strengthens generalizability, but is limited by heterogeneity across included studies, differences in operator expertise, and variable reference standards. Some included studies also rely on convenience sampling, which may overestimate diagnostic performance.

The prospective and cohort studies share several strengths including real-world emergency department or inpatient applicability, direct head-to-head or near-comparative assessment with radiology duplex, and focus on clinically meaningful endpoints such as time-to-diagnosis and bedside feasibility. However, they also demonstrate consistent limitations including small to

moderate sample sizes, single-center designs limiting external validity, operator dependency (results vary significantly between expert sonographers and trainees), inconsistent inclusion of distal (calf) DVT evaluation, and variable reference standards and blinding quality. A recurring theme is that diagnostic accuracy is highly dependent on clinician experience and adherence to standardized scanning protocols.

Across studies, POCUS generally shows high sensitivity for proximal DVT (often ~85–95%) and high specificity (~90–95%) in experienced hands. The most clinically relevant effect is not absolute diagnostic superiority, but time reduction—with POCUS frequently providing immediate bedside answers compared with delayed radiology imaging.

Importantly, the negative predictive value is high in low-to-moderate pretest probability patients, supporting its use as a rule-out tool. However, sensitivity drops in distal DVT and in less experienced operators, which limits standalone use in high-risk presentations.

The key clinical impact is workflow acceleration and earlier decision-making for faster exclusion of proximal DVT in low-risk patients, earlier initiation of anticoagulation in high-probability cases, reduced reliance on radiology availability after hours

However, the clinical significance is constrained by the fact that missed distal or isolated calf DVTs may still occur, and these may progress or embolize in select patients. Thus, a negative POCUS does not universally equate to “no DVT,” particularly in high-risk presentations.

Other Considerations include operator training is the dominant determinant of accuracy, standardization (3-point compression protocols) improves reliability, radiology duplex remains superior for full-leg evaluation and complex anatomy (e.g., obesity, edema, prior DVT), medicolegal considerations still favor radiology confirmation in equivocal or high-risk cases

Despite strong diagnostic signal, evidence is insufficient to fully replace radiology imaging. Key gaps include lack of large multicenter randomized outcome trials (diagnostic accuracy ≠ patient outcome benefit), unclear minimum training threshold to achieve reliable competency, limited subgroup data (pregnancy, recurrent DVT, obesity, distal DVT suspicion), insufficient standardization across scanning protocols, and need for studies assessing whether POCUS reduces PE rates, morbidity, or healthcare utilization

The Clinical Bottom Line is that POCUS performed by trained clinicians is a highly effective, rapid diagnostic tool for identifying or excluding proximal DVT, with performance approaching radiology-performed duplex in ideal conditions. However, due to heterogeneity in operator skill, protocol variation, and reduced sensitivity for distal disease, it should be considered a first-line bedside rule-out and triage modality, not a definitive replacement for formal radiology duplex ultrasound. Radiology remains necessary for confirmation in high-risk, technically difficult, or equivocal cases.

Citations:

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