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Original Research Article

# Clinical significance of elevated D-Dimer in Emergency Department patients: a retrospective single-center analysis at Patna Medical College and Hospital

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**Abstract:**

**Background:** D-dimer testing is widely used in the ED to assess suspected VTE, but elevated levels may reflect a range of non-thrombotic conditions. This study aimed to determine the prevalence, diagnostic performance and clinical significance of elevated D-dimer values among ED patients in a tertiary-care setting.

**Methods:** This retrospective single-center study included adult ED patients (≥18 years) who underwent D-dimer testing at Patna Medical College and Hospital between January and November 2024. Demographic profiles, comorbidities, laboratory values, imaging results and clinical outcomes were collected. Elevated D-dimer was defined as ≥0.5 µg/mL FEU. Diagnostic performance for imaging-confirmed VTE (CTPA or venous Doppler) was assessed using sensitivity, specificity, predictive values and ROC analysis. Logistic regression evaluated associations between elevated D-dimer and outcomes including hospital admission, ICU transfer and in-hospital mortality.

**Results:** A total of 112 patients were included (median age 56 years; 57.1% male). Elevated D-dimer was observed in 74 patients (66.1%). Imaging confirmed VTE in 18 patients (16.1%). Using the standard cutoff, D-dimer demonstrated high sensitivity (94.4%) and NPV (97.4%) but low specificity (39.4%). Age-adjusted thresholds improved specificity to 52.1% with preserved sensitivity. Elevated D-dimer was significantly associated with hospital admission (adjusted OR 4.2; 95% CI 1.8–9.7), but not with in-hospital mortality.

**Conclusion:** Elevated D-dimer levels were common in ED patients and remained highly sensitive but poorly specific for VTE. Age-adjusted cutoffs enhanced specificity without compromising sensitivity. Elevated D-dimer independently predicted the need for hospital admission but did not predict mortality, underscoring the importance of clinical context when interpreting D-dimer results.

**Keywords:** D-dimer; Emergency Department; Venous Thromboembolism; Diagnostic Accuracy; Age-adjusted Cutoff; Retrospective Study; Hospital Admission.



## Introduction

D-dimer testing has become a routine component of emergency department (ED) evaluation, particularly when patients present with symptoms that prompt concern for venous thromboembolism (VTE). Because it reflects ongoing fibrin breakdown, a raised D-dimer level often signals active clot formation somewhere in the body. For clinicians, this makes D-dimer a valuable tool when trying to rule out PE or DVT in patients with a low or intermediate pretest probability. Its widespread use stems from its high sensitivity, ease of availability, and rapid turnaround, all of which support timely decision-making in acute care settings [1,2].

Despite its usefulness, an elevated D-dimer result does not point exclusively to VTE. Many clinical conditions routinely encountered in the ED—such as severe infection, malignancy, trauma, recent surgery, chronic medical illness, and even the physiological effects of ageing—can raise D-dimer levels without the presence of thrombosis. This lack of specificity often complicates interpretation and may trigger additional investigations that ultimately prove unnecessary [3]. In busy public hospitals with limited imaging capacity, such as many centres across India, this issue becomes particularly important. Deciding when an elevated D-dimer

warrants immediate imaging and when it does not require a careful balance between clinical judgement and resource management [4,5].

To refine interpretation, age-adjusted D-dimer thresholds have been introduced and widely studied, showing that specificity improves in older adults without significantly affecting sensitivity. However, most of the evidence comes from Western populations. Indian EDs deal with a different pattern of diseases, higher rates of late presentations, and diverse comorbid profiles. As a result, it is uncertain whether these adjusted thresholds perform similarly in local settings. At the same time, interest has grown in understanding whether D-dimer has value beyond diagnosing VTE—particularly whether elevated levels might serve as markers of illness severity or predict short-term outcomes such as admission, ICU requirement or early mortality [6,7].

Considering these uncertainties, there is a need to evaluate how D-dimer behaves in real-world ED practice in India. Patna Medical College and Hospital serve a high-volume, high-acuity patient population, offering an ideal setting to study this question. This retrospective analysis, covering the period from January to November 2024, examines how frequently D-dimer is elevated, how well it performs in identifying VTE, and whether raised levels correspond to more serious clinical outcomes. By focusing on both diagnostic and prognostic dimensions, the study aims to clarify the practical significance of D-dimer levels in an Indian tertiary-care ED and support more informed, context-appropriate clinical decisions [8].

## Methods

**Study Design and Setting:** The Emergency Department (ED) at Patna Medical College and Hospital, a tertiary-care teaching facility in eastern India, was the site of this retrospective observational study. The study period spanned eleven months, from 1 January 2024 to 30 November 2024. All data were retrieved from the hospital's electronic records and laboratory information system.

**Study Population:** The study included all adult patients (≥18 years) who underwent D-dimer testing during their ED visit within the study period. If a patient had multiple D-dimer measurements during the same episode of care, only the first result was considered. Patients were excluded if the laboratory value was missing, inconsistent, or if essential clinical or imaging details were not available for analysis.

**Data Collection:** Demographic information, presenting complaints, vital signs at ED arrival, and relevant comorbidities (including active malignancy, recent surgery, chronic kidney disease and sepsis) were extracted from medical records. Laboratory parameters included the numeric D-dimer value, units, and assay method. D-dimer concentrations were reported in µg/mL FEU, and values ≥0.5 µg/mL FEU were classified as elevated based on the institutional reference range. Age-adjusted D-dimer thresholds (age × 0.01 µg/mL FEU for patients >50 years) were calculated for secondary analyses.

Information on diagnostic imaging—including CT pulmonary angiography (CTPA) and venous Doppler ultrasonography—was reviewed to confirm VTE. ED disposition (discharge, ward admission, ICU admission) and in-hospital outcomes, including mortality, were recorded. All data were de-identified prior to analysis.

**Outcome Measures:** The primary diagnostic outcome was imaging-confirmed VTE. Clinical outcomes included hospital admission, ICU transfer and in-hospital mortality. The presence of elevated D-dimer and its association with these outcomes were evaluated.

**Statistical Analysis:** Continuous variables were summarized using means with SD or medians with IQR, depending on distribution. Categorical variables were expressed as frequencies and percentages. Comparisons between patients with normal and elevated D-dimer levels employed the chi-square test or Fisher's exact test for categorical data, and the t-test or Mann–Whitney U test for continuous variables.

Diagnostic performance of D-dimer for VTE was assessed using specificity, sensitivity, PPV and NPV, and likelihood ratios. ROC curves were generated, and AUC values with 95% CI were calculated. Multivariable logistic regression was performed to examine the association between elevated D-dimer and selected clinical outcomes, adjusting for key confounders such as sex, age, and presence of active cancer. Variables were selected a priori, and model complexity was restricted to avoid overfitting given the sample size. Standard statistical software was used for all analyses, and a p-value of less than 0.05 was deemed statistically significant.

**Ethical Considerations:** The Patna Medical College and Hospital's IEC approved the study protocol. Informed permission was not required because this was a retrospective analysis of anonymised records.

## Results

**Study Population:** During the 11-month study period, 126 ED patients underwent D-dimer testing. After excluding 14 patients due to incomplete records or duplicate entries, 112 patients were included in the final analysis. The cohort consisted mainly of middle-aged and older adults, with a median age of 56 years (IQR 42–68), and a slight

predominance of males (57.1%). A visual representation of the study flow is shown below.

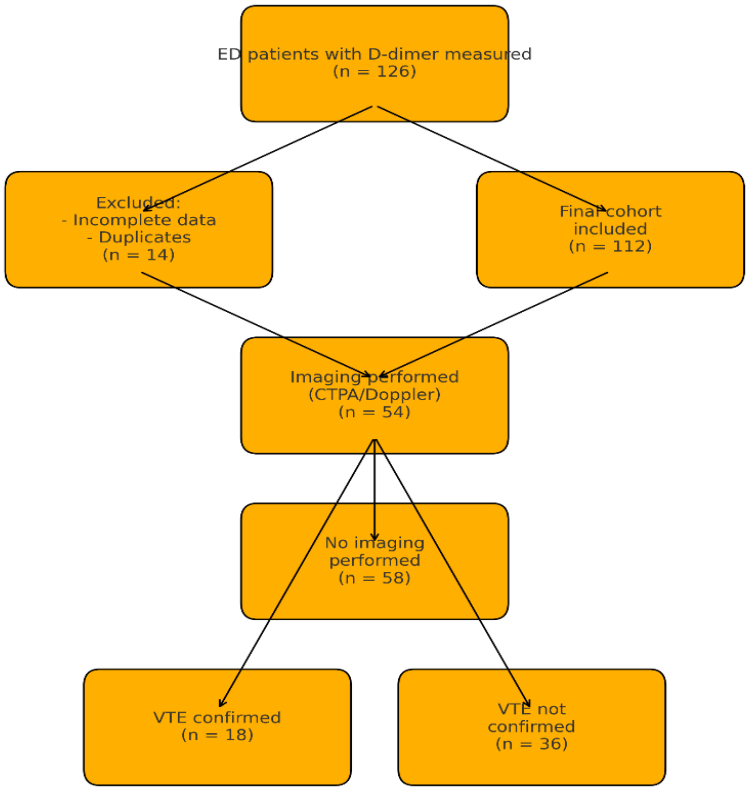


**Figure 1: Study Flow Diagram**

**Baseline Characteristics:** Most patients presented with dyspnea, chest pain, fever or limb symptoms. Comorbidities such as malignancy, recent surgery and chronic kidney disease were present in a minority but were more common among those with elevated D-dimer levels. Overall, 74 patients (66.1%) had a D-dimer ≥0.5 µg/mL FEU.

**Table 1: Baseline Characteristics of the Study Population (N = 112)**

| Variable | Total (N = 112) |
|---|---|
| **Age, median (IQR), years** | 56 (42–68) |
| **Male sex — n (%)** | 64 (57.1%) |
| **Presenting complaints** | |
| Dyspnea — n (%) | 44 (39.3%) |
| Chest pain — n (%) | 21 (18.8%) |
| Fever/sepsis — n (%) | 20 (17.9%) |
| Limb pain/swelling — n (%) | 12 (10.7%) |
| **Comorbidities** | |
| Active cancer — n (%) | 12 (10.7%) |
| Recent surgery — n (%) | 9 (8.0%) |
| CKD — n (%) | 8 (7.1%) |
| **D-dimer, median (IQR), µg/mL FEU** | 0.85 (0.42–2.40) |
| **D-dimer ≥0.5 µg/mL FEU — n (%)** | 74 (66.1%) |
| **Imaging (CTPA/Doppler) performed — n (%)** | 54 (48.2%) |
| **Imaging-confirmed VTE — n (%)** | 18 (16.1%) |

**D-dimer and Venous Thromboembolism:** Among the 54 patients who underwent imaging, VTE was confirmed in 18 (16.1% of total cohort). At the typical laboratory threshold, D-dimer had good sensitivity but low specificity. Only one VTE patient had a D-dimer below 0.5 µg/mL FEU.

Using age-adjusted thresholds reduced false positives and modestly improved specificity while preserving sensitivity. ROC analysis yielded an AUC of 0.78 (95% CI 0.68–0.88), indicating fair discriminative ability.

**Table 2: Diagnostic Performance of D-dimer for Imaging-Confirmed VTE**

| Metric | Standard Cutoff (≥0.5 µg/mL) | Age-Adjusted Cutoff |
|---|---|---|
| **Sensitivity** | 94.4% (17/18) | 94.4% |
| **Specificity** | 39.4% (37/94) | 52.1% |
| **PPV** | 23.0% (17/74) | 27.4% |
| **NPV** | 97.4% (37/38) | 98.0% |
| **ROC AUC** | 0.78 (95% CI 0.68–0.88) | — |

**Clinical Outcomes:** Hospital admission was required for 69.6% of patients, with significantly higher admission rates among those with elevated D-dimer (83.8% vs 42.1%, $p < 0.001$). ICU transfer occurred in 10.7% of patients, all of whom belonged to the elevated D-dimer group. Six patients (5.4%) died during hospitalization; mortality was not significantly associated with D-dimer category due to the small number of events.

Logistic regression demonstrated that elevated D-dimer independently predicted hospital admission (adjusted OR 4.2; 95% CI 1.8–9.7). The association with ICU transfer weakened after adjusting for age and comorbidity, and D-dimer did not show a statistically significant relationship with in-hospital mortality.

**Table 3: Outcomes by D-dimer Category**

| Outcome | Normal D-dimer (n = 38) | Elevated D-dimer (n = 74) | p-value |
|---|---|---|---|
| **Hospital admission — n (%)** | 16 (42.1%) | 62 (83.8%) | <0.001 |
| **ICU transfer — n (%)** | 0 (0%) | 12 (16.2%) | 0.010 |
| **In-hospital mortality — n (%)** | 1 (2.6%) | 5 (6.8%) | 0.32 |

## Discussion

This study evaluated the clinical meaning of elevated D-dimer values in adults presenting to a tertiary ED and found that a substantial proportion of patients exhibited higher-than-normal levels. Among those who underwent imaging, VTE accounted for a meaningful share of these elevations, but many patients without thromboembolic disease also showed raised results. The analysis confirmed that the standard laboratory threshold offered excellent ability to rule out VTE but performed poorly in separating thrombotic from non-thrombotic causes. The improved specificity observed with age-adjusted thresholds, although modest, indicates that tailored cutoffs may be beneficial in emergency settings with diverse patient profiles [9,10].

In the present cohort, very few patients with confirmed VTE had D-dimer values below the standard cutoff, reinforcing the reliability of the test as an initial filter in suspected cases. However, the large number of patients with elevated D-dimer and no imaging-confirmed VTE underscores the biomarker's limitations when used without appropriate contextual interpretation. Rather than serving as an indicator of a specific diagnosis, D-dimer in this environment functioned more as a signal of physiological disturbance. This broad elevation pattern complicates diagnostic pathways and may drive imaging decisions that do not ultimately change patient management, particularly when the clinical picture suggests an alternative cause for symptoms [11,12].

The application of age-adjusted D-dimer thresholds demonstrated clear operational advantages in this study. While the improvement in specificity was not dramatic, the reduction in false positives is meaningful in a high-volume emergency department where access to definitive imaging is often limited. The unchanged sensitivity with this adjustment is reassuring, as it indicates that clinically significant thrombotic disease was not missed when higher cutoffs were applied in older patients. These findings support the gradual adoption of flexible thresholds tailored to patient demographics rather than reliance on a fixed universal value [13,14].

The association between elevated D-dimer and hospital admission reflects a consistent pattern in which higher levels correlate with greater overall illness burden rather than a single pathological process. Patients with elevated values more frequently required inpatient care and, in a minority of cases, ICU monitoring. Although the number of ICU admissions was small, the absence of such admissions among those with normal D-dimer suggests that the marker may offer some value in early risk identification. Importantly, elevated D-dimer did not predict mortality in this study, a finding likely influenced by both the small number of deaths and the short follow-up interval. The lack of mortality association also emphasizes that elevated D-dimer should not be interpreted as an

automatic indicator of poor prognosis without supporting clinical evidence[15,16].

These results have practical implications for emergency physicians who must balance diagnostic thoroughness with resource constraints. The test remains valuable for excluding VTE, but its widespread elevation among patients with non-thrombotic conditions calls for a more selective approach to its use. Incorporating age-adjusted values, alongside structured clinical assessment tools, may help prevent unnecessary imaging and reduce ED congestion. Additionally, the association between high D-dimer and the likelihood of admission suggests that the marker could be incorporated into broader risk assessment frameworks to aid decision-making, especially when managing undifferentiated acute presentations [17].

The study's strengths include its real-world dataset and integration of both diagnostic and outcome analyses, offering a practical understanding of D-dimer behavior in a busy emergency department. Nonetheless, several limitations must be acknowledged. Because imaging was not performed in all patients, some cases of VTE may have gone undetected. The retrospective design relies on the completeness of clinical records, and missing details may have influenced the classification of comorbidities or presenting complaints. Additionally, the limited number of adverse outcomes restricted deeper examination of mortality and ICU predictors. The absence of standardized clinical probability scoring in most records also prevented analysis of D-dimer performance within validated risk categories [18].

Notwithstanding these drawbacks, this study offers essential information about the complex function of D-dimer testing in emergency medicine. The findings affirm its usefulness for ruling out VTE while highlighting the caution required when interpreting elevated results. Adjusted thresholds appear to improve practical decision-making without compromising diagnostic safety. Elevated D-dimer levels were more closely aligned with overall clinical acuity than with mortality, suggesting that the test may offer additional value as a marker of illness severity. Future prospective studies incorporating clinical probability tools and larger populations may help refine D-dimer–based decision strategies and strengthen their applicability in diverse emergency settings.

## Conclusion

In this retrospective study of emergency department patients, elevated D-dimer values were frequently encountered and were associated with a broad range of clinical presentations. Although the standard cutoff retained excellent sensitivity for excluding venous thromboembolism, its limited specificity resulted in a substantial number of false-positive results. The use of age-adjusted thresholds modestly improved specificity while preserving diagnostic safety, supporting their consideration in routine practice. Elevated D-dimer was also associated with higher rates of hospital admission and ICU utilization, suggesting that it may reflect overall illness severity rather than thrombosis alone. However, no significant association was observed with short-term in-hospital mortality. These findings highlight the importance of interpreting D-dimer in conjunction with clinical assessment and imaging availability. Larger prospective studies incorporating standardized pretest probability assessments may help refine its diagnostic and prognostic value in resource-constrained emergency settings.

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