

Evaluating Scoring Systems and Biomarkers for Disseminated Intravascular Coagulation in Critically Ill Patients: A Prospective Cohort Study

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ABSTRACT

Introduction: Disseminated Intravascular Coagulation (DIC) is a critical haemostatic disorder marked by systemic activation of coagulation, leading to microvascular thrombosis, consumption of clotting factors, and bleeding. Multiple diagnostic criteria exist however, no universally accepted gold standard is available, and their comparative performance varies across clinical settings.

Aim: To evaluate and compare the diagnostic performance of four DIC scoring systems the International Society on Thrombosis and Haemostasis (ISTH), Japanese Association for Acute Medicine (JAAM), Japanese Ministry of Health and Welfare (JMHW), and Korean Society on Thrombosis and Haemostasis (KSTH) in critically ill patients.

Materials and Methods: The present prospective cohort study was conducted in the Intensive Care Units (ICUs) of a superspeciality teaching hospital in Pune, Maharashtra, India, from 1 June 2023 to 29 February 2024. Thirty-five consecutive adults with clinical suspicion of DIC were enrolled. Baseline haemostatic parameters including platelet count, Prothrombin Time (PT), Activated Partial Thromboplastin Time (aPTT), fibrinogen, D-dimer, Red Cell Distribution Width (RDW), and Antithrombin III (ATIII) activity-were measured at admission. Overt DIC was defined according to the ISTH criteria (score ≥ 5). The diagnostic performance of the JAAM, JMHW, and KSTH scoring systems was evaluated using ISTH as the reference standard. Statistical analyses included descriptive statistics, independent t-test or Mann-Whitney U-test for continuous variables, Chi-

square or Fisher's exact test for categorical variables, and Receiver Operating Characteristic (ROC) curve analysis with calculation of Area Under the Curve (AUC). Correlations between scoring systems and laboratory parameters were assessed using Pearson's correlation coefficient. All analyses were performed using IBM Statistical Package for Social Sciences (SPSS) Statistics version 25.0 (IBM Corp., Armonk, NY, USA), with $p < 0.05$ considered statistically significant.

Results: Overt DIC was identified in 22 of 35 patients (62.9%), and overall mortality was 28.5% (10/35). Patients demonstrated prolonged PT (19.2 ± 4.8 s), elevated aPTT (42.5 ± 9.2 s) and D-dimer levels ($2,480 \pm 1,050$ ng/mL), reduced fibrinogen (168 ± 74 mg/dL), and low ATIII activity ($62 \pm 14\%$). Diagnostic accuracy relative to ISTH was highest for JAAM (AUC 0.80; 95% Confidence Intervals (CI) 0.65-0.93) and KSTH (AUC 0.76; 95% CI 0.61-0.90), while JMHW showed lower performance (AUC 0.72; 95% CI 0.56-0.87). Correlations with ISTH scores were as follows: platelet count $r = -0.48$ ($p = 0.009$), PT $r = 0.52$ ($p = 0.004$), D-dimer $r = 0.45$ ($p = 0.012$), and ATIII activity $r = -0.43$ ($p = 0.010$). RDW showed a weak, non-significant association with ISTH score ($r = 0.18$, $p = 0.301$).

Conclusion: The ISTH scoring system demonstrated the strongest diagnostic reliability for DIC, while JAAM and KSTH provided comparable sensitivity. Conventional coagulation markers and ATIII activity correlated well with disease severity, supporting their routine diagnostic utility. RDW showed limited discriminative and prognostic value.

Keywords: Haemostatic disorder, International society on thrombosis and haemostatis, Microvascular thrombosis

INTRODUCTION

Disseminated intravascular coagulation (DIC) is an acquired syndrome of systemic coagulation activation that leads to intravascular fibrin formation, microvascular thrombosis, and subsequent organ dysfunction. Clinically, it presents with both thrombotic complications and bleeding tendencies due to consumption of coagulation factors and platelets. DIC occurs in association with sepsis, trauma, malignancy, liver disease, and obstetric disorders, and consistently carries a poor prognosis, with mortality approaching 50% in critically ill patients [1].

Reported prevalence varies according to the study population and diagnostic approach. In ICUs, DIC prevalence ranges from 8.5% to 34%, with sepsis being the most common precipitating factor. Approximately 30-50% of septic patients develop DIC, and mortality among those fulfilling diagnostic criteria is significantly higher than among those without DIC [1,2].

DIC represents a final common pathway of systemic coagulation activation, resulting in widespread microvascular thrombosis, consumption of clotting factors and platelets, and paradoxical bleeding. Its clinical and laboratory features evolve depending

on the underlying condition, patient co-morbidities, and timing of assessment. The syndrome lies at the intersection of inflammation, coagulation, and endothelial dysfunction.

Contemporary understanding highlights dysregulated crosstalk between inflammatory and coagulation pathways, characterised by tissue factor-mediated thrombin generation, impaired natural anticoagulants such as antithrombin and protein C, and suppressed fibrinolysis due to elevated Plasminogen Activator Inhibitor-1 (PAI-1) [2,3]. Endothelial activation further amplifies this imbalance, while consumption of platelets and fibrinogen and secondary fibrinolysis contribute to bleeding in advanced stages [4-6].

Given this mechanistic complexity, diagnosis remains challenging, as no single laboratory test can confirm DIC. Composite scoring systems integrating platelet count, coagulation times, fibrin-related markers, and fibrinogen are therefore recommended. The ISTH overt DIC score is the most widely used, while the JAAM, JMHW, and KSTH criteria are also validated [7-13].

The JAAM and related Japanese criteria emphasise early detection, whereas the ISTH score prioritises higher specificity for overt consumptive DIC. Comparative studies across sepsis, trauma,

and obstetric populations demonstrate variability in sensitivity and prognostic performance, underscoring the importance of context-specific application.

Beyond these established systems, the Sepsis-Induced Coagulopathy (SIC) score was developed to align coagulation assessment with updated sepsis definitions, enabling earlier identification of patients at risk of progression to overt DIC [8,11,14-16]. Trauma-induced coagulopathy and obstetric DIC represent related but distinct entities with unique pathophysiological and clinical implications. Trauma-associated DIC arises from tissue injury, shock, acidosis, and hyperfibrinolysis, whereas obstetric DIC is characterised by rapid haemostatic deterioration and profound hypofibrinogenaemia [6,17-20].

Routine laboratory tests incorporated into DIC scoring systems—platelet count, PT, aPTT, fibrinogen, and fibrin degradation products or D-dimer—remain the cornerstone of diagnosis and prognostication. However, additional biomarkers have gained interest as adjunctive indicators of disease severity and outcome.

Natural anticoagulants play a central role in coagulation homeostasis. Antithrombin, the primary endogenous inhibitor of thrombin, is markedly reduced in severe sepsis and DIC and correlates with adverse outcomes [21-23]. Low ATIII levels reflect ongoing consumption and impaired anticoagulant defence. Although interventional trials have yielded mixed results regarding supplementation, the consistent association between reduced ATIII activity and mortality supports its prognostic relevance.

The RDW, a measure of anisocytosis routinely reported in automated blood counts, has emerged as a reproducible prognostic index in sepsis and DIC [24-28]. Higher baseline RDW values or early increases during hospitalisation have been associated with DIC development, greater sepsis severity, and increased mortality. Fan YW et al., reported that elevated RDW Standard Deviation (SD) and dynamic fluctuations predicted both DIC incidence and 28-day mortality in septic patients [24].

The appeal of RDW lies in its low cost, universal availability, and ease of integration into routine laboratory workflows, making it particularly valuable in resource-limited settings. However, RDW lacks specificity, as it is influenced by anaemia, inflammation, and erythropoietic stress; therefore, it should be interpreted in conjunction with clinical findings and coagulation parameters.

Other condition-specific parameters have also been recognised, such as fibrinogen levels in obstetric DIC, markers of endothelial activation (e.g., thrombomodulin, syndecan-1), and fibrinolytic indicators such as PAI-1 [17,18]. Despite these advances, diagnostic heterogeneity persists, underscoring the need for harmonisation and validation of scoring systems across diverse populations.

Comparative performance studies have evaluated DIC criteria in sepsis, trauma, and obstetric cohorts. In sepsis-related analyses, JAAM and DIC scores tend to identify patients earlier, whereas ISTH and JMHW criteria demonstrate greater specificity for overt DIC [8,11,14-16]. In trauma cohorts, early recognition of coagulopathy using modified criteria assists with transfusion guidance and prognostication [6,19,20]. Obstetric studies emphasise rapid fibrinogen assessment and tailored algorithms integrating clinical and laboratory findings [17,18]. Large multicentre and population-based studies have sought to harmonise these definitions and evaluate their predictive validity for mortality and organ failure [7-13].

Management of DIC remains largely supportive and focuses on treating the underlying cause such as antimicrobial therapy and source control in sepsis, surgical intervention in trauma or obstetric haemorrhage, and appropriate replacement of depleted blood components. Antithrombin supplementation, recombinant thrombomodulin, and other targeted therapies have shown variable results [22,23,29]. Meta-analyses highlight substantial heterogeneity in study design, timing, and patient selection, suggesting that these therapies may benefit specific subgroups but are not recommended for universal use [22,29].

The diversity of clinical trial outcomes underscores the importance of pragmatic, locally relevant research, particularly in low and middle income countries where cost and resource constraints limit access to advanced therapies.

Accurate and timely diagnosis of DIC is essential in critically ill patients, especially those with sepsis, trauma, malignancy, or obstetric complications. In the present superspeciality setting, which serves a broad spectrum of such patients, evaluating the diagnostic performance of established DIC scoring systems alongside adjunctive biomarkers is of considerable clinical importance.

The present study was undertaken with the primary objective of comparing the diagnostic performance of four DIC scoring systems—ISTH, JAAM, JMHW, and KSTH in critically ill patients. Secondary objectives included describing the clinical and haemostatic characteristics of patients with suspected DIC and evaluating associations of two readily available biomarkers, RDW and ATIII activity, with ISTH scores and mortality outcomes. By integrating established scoring frameworks with adjunctive biomarker assessment, the present study aimed to identify reliable predictors of DIC severity and progression, thereby enhancing diagnostic accuracy and risk stratification in Indian ICU practice.

MATERIALS AND METHODS

The present prospective observational study was conducted in the pathology laboratory of an 800-bedded superspeciality teaching hospital in Pune, Maharashtra, India, from 1 June 2023 to 29 February 2024. The study protocol was reviewed and approved by the Institutional Ethics Committee Ref: RHC/BIOPMRFIEC/2023/430), and the study was conducted in accordance with the Declaration of Helsinki.

Inclusion criteria: The study population included all adult patients (>18 years) of either gender admitted to various ICUs with clinical features and underlying conditions known to be associated with DIC, such as sepsis, trauma, malignancy, and obstetric complications.

Exclusion criteria: Consecutive patients fulfilling these criteria during the study period were enrolled after verification of relevant clinical and laboratory data. Patients admitted for less than 24 hours were excluded.

Sample size calculation: The sample size was calculated using the single-proportion formula $n = (Z^2 \times p \times (1-p))/d^2$. The expected proportion ($p=0.149$) was derived from published data by Dixit A et al., [30]. Assuming a 95% CI ($Z=1.96$) and an allowable error ($d=0.13$), the estimated sample size was 28.8. After accounting for a 20% potential dropout rate, a final sample size of 35 patients was included in the study.

Study Procedure

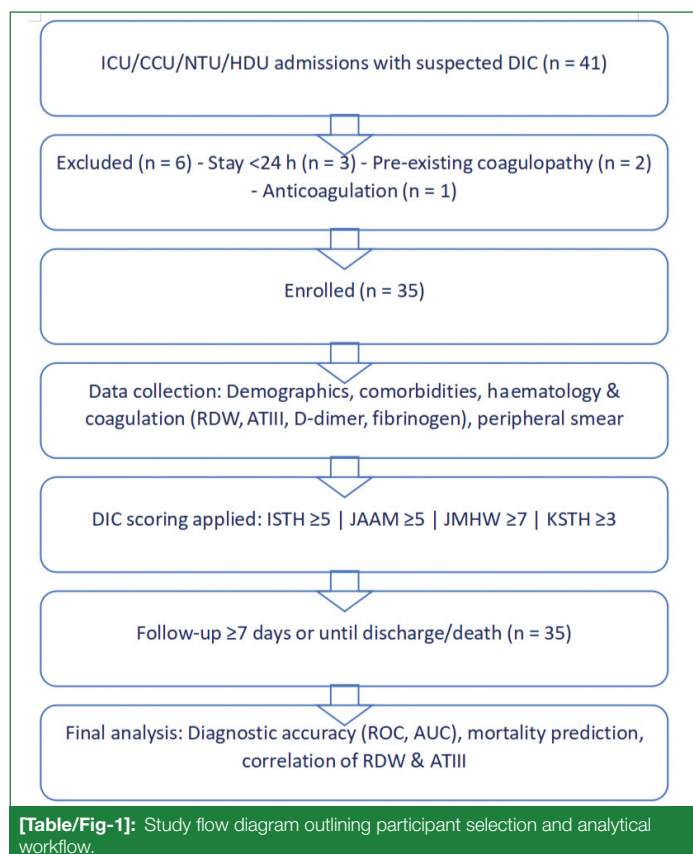
For all eligible cases, detailed demographic and clinical information including age, gender, Systemic Inflammatory Response Syndrome (SIRS) score [31], and DIC scoring parameters was recorded. Routine haematological and haemostatic investigations were retrieved from laboratory records, including Complete Blood Count (CBC), PT (reference range 9.4-12.5 s), aPTT (reference range 25-36 s), fibrinogen (reference range 150-450 mg/dL), D-dimer (reference range ≤ 243 ng/mL), and ATIII activity (reference range 80-120%).

Peripheral blood smear examinations were performed for all patients, and morphological findings were correlated with haemogram results and DIC status. All laboratory investigations were requested by treating clinicians as part of routine patient care; no additional sample collection was performed specifically for the study.

Each patient was followed for a minimum of seven days from admission or until outcome, whichever occurred first.

A flowchart illustrating the screening of Intensive Care Unit (ICU)/Cardiac care unit (CCU)/Nephelometric Turbidity Unit (NTU)/High Dependency Unit (HDU) admissions for suspected DIC, exclusions, final enrolment, data collection, application of the

four DIC scoring systems, and follow-up through diagnostic and prognostic analyses is shown in [Table/Fig-1].



STATISTICAL ANALYSIS

The compiled data were entered into a Microsoft Excel spreadsheet and subsequently analysed using IBM SPSS Statistics version 25.0 (IBM Corp., Armonk, NY, USA). Continuous variables were expressed as mean±SD, while categorical variables were summarised as frequencies and percentages. Normality of data distribution was assessed using the Shapiro-Wilk test. Between-group comparisons of continuous variables were performed using the Student's t-test or the Mann-Whitney U-test, as appropriate. Categorical variables were analysed using the Chi-square test or Fisher's exact test. To evaluate the diagnostic performance of the different scoring systems (ISTH, JAAM, KSTH, and JMHW), mean ± SD scores and the proportion of patients meeting DIC criteria were calculated. Pearson's correlation coefficient (*r*) was used to assess relationships between ISTH scores and the other scoring systems, as well as between ISTH scores and ATIII activity and RDW. Correlation strength was interpreted as weak ($r < 0.3$), moderate ($r = 0.3-0.7$), or strong ($r > 0.7$). A *p*-value < 0.05 was considered statistically significant. All statistical findings were summarised in tabular form.

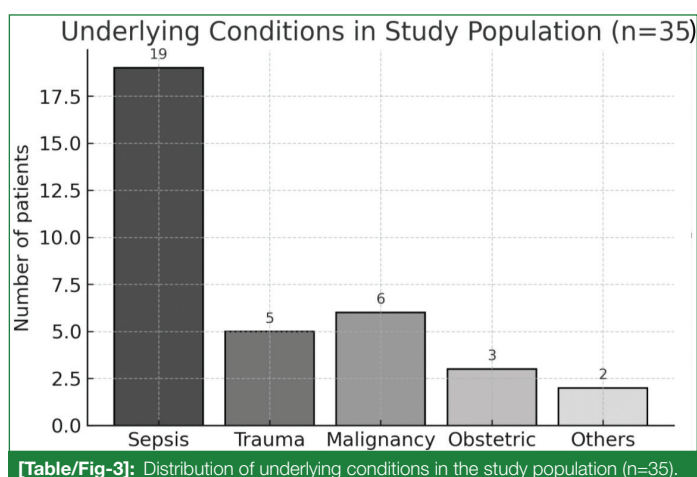
RESULTS

A total of 35 critically ill patients meeting criteria for suspected DIC were enrolled, with a mean age of 52.3 ± 14.6 years. The study population reflected a heterogeneous ICU case mix encompassing sepsis, trauma, malignancy, and obstetric complications [Table/Fig-2].

A bar chart illustrates the distribution of underlying clinical conditions among the study cohort. Sepsis was the most common condition ($n=19$), followed by malignancy ($n=6$), trauma ($n=5$), obstetric complications ($n=3$), and other miscellaneous causes ($n=2$). The height of each bar represents the number of patients in each category, with numerical values displayed above the bars for clarity [Table/Fig-3].

Parameters	N (%) or Mean±SD	Reference range
Demographics and clinical profile		
Age (years)	52.3±14.6	22-79
Male (gender)	21 (60.0)	-
ICU stay (days)	9.2±3.8	3-17
Sepsis as underlying condition	19 (54.3)	-
Trauma	5 (14.3)	-
Malignancy	6 (17.1)	-
Obstetric complications	3 (8.6)	-
Others	2 (5.7)	-
Haematological and Haemostatic Parameters		
Haemoglobin (g/dL)	9.8±2.1	12-16
Platelet count ($\times 10^9/L$)	76±32	150-450
Total leukocyte count (/mm ³)	14,200±5,600	4,000-11,000
RDW (%)	17.3±2.1	11.5-14.5
Prothrombin Time (PT) (sec)	19.2±4.8	9.4-12.5
aPTT (sec)	42.5±9.2	25-35
Fibrinogen (mg/dL)	168±74	150-450
D-dimer (ng/mL)	2,480±1,050	<243
Antithrombin (AT) activity (%)	62±14	90-150

[Table/Fig-2]: Baseline demographic, clinical, and laboratory characteristics of patients with DIC.



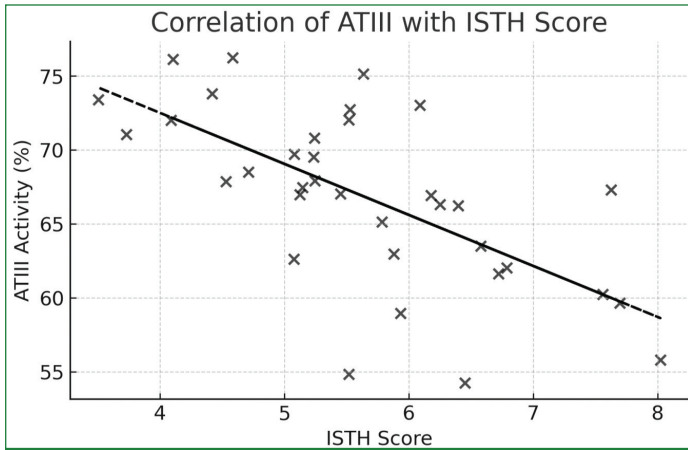
Patients consistently demonstrated haematological and coagulation abnormalities characterised by anaemia, thrombocytopenia, and laboratory evidence of coagulopathy. Mean PT (19.2 ± 4.8 s), aPTT (42.5 ± 9.2 s), and D-dimer levels ($2,480 \pm 1,050$ ng/mL) were markedly elevated compared with reference ranges, while fibrinogen (168 ± 74 mg/dL) and ATIII activity ($62 \pm 14\%$) were reduced [Table/Fig-2].

When evaluated using established scoring systems, the ISTH criteria identified the highest number of overt DIC cases, reaffirming its diagnostic reliability in this critically ill cohort. The JAAM and KSTH systems showed good concordance with ISTH and were more sensitive for early recognition, whereas the JMHW score exhibited lower sensitivity and tended to classify patients at later stages of disease.

Correlation analyses revealed significant associations between ISTH DIC scores and individual coagulation markers. PT ($r=0.52$, $p=0.004$), D-dimer ($r=0.45$, $p=0.012$), and platelet count ($r=-0.48$, $p=0.009$) demonstrated strong correlations with overall DIC severity. ATIII activity showed a significant inverse relationship with ISTH scores ($r=-0.43$, $p=0.010$), indicating progressive depletion of natural anticoagulant capacity with increasing disease severity.

Patients fulfilling ISTH criteria for overt DIC (score ≥ 5) consistently exhibited lower ATIII activity, supporting its potential role as an adjunctive biomarker of disease progression. RDW demonstrated a weak and non-significant correlation with ISTH scores ($r=0.18$, $p > 0.05$), indicating limited diagnostic utility.

Overall mortality occurred in 10 of 35 patients (28.5%), allowing ROC based evaluation of mortality prediction across the different scoring systems [Table/Fig-4].



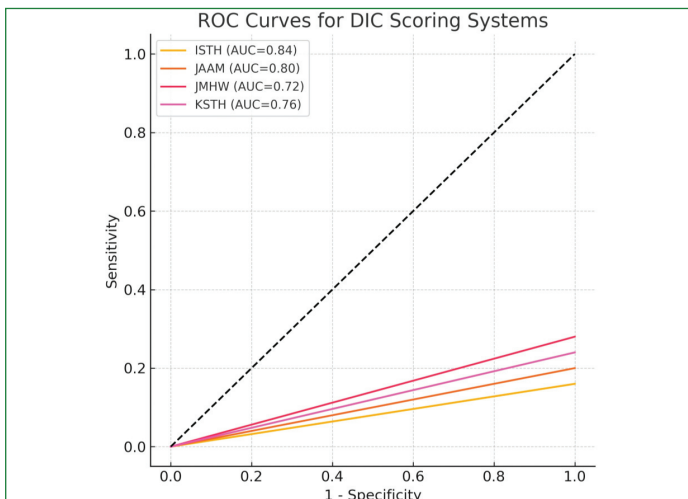
[Table/Fig-4]: Correlation of ATIII activity with ISTH scores.

[Table/Fig-5] summarises the proportion of patients classified as overt DIC, mean±SD scores, and diagnostic accuracy metrics-including area under the ROC curve (AUC), sensitivity, specificity, and p-values for the ISTH, JAAM, JMHW, and KSTH scoring systems. AUC values are presented with 95% CI. Lower p-values indicate higher statistical significance of the model's discriminative ability. The table highlights interscore concordance and associations with key biomarkers.

Scoring system	Overt DIC n (%)	Mean score ±SD	AUC (95% CI)	Sensitivity (%)	Specificity (%)	p-value
ISTH	22 (62.9)	5.8±1.2	0.84 (0.70-0.95)	81.8	78.6	<0.001
JAAM	24 (68.6)	6.1±1.4	0.80 (0.65-0.93)	77.3	75.0	0.002
JMHW	18 (51.4)	7.2±1.0	0.72 (0.56-0.87)	68.2	71.4	0.015
KSTH	20 (57.1)	3.4±0.8	0.76 (0.61-0.90)	72.7	73.2	0.006

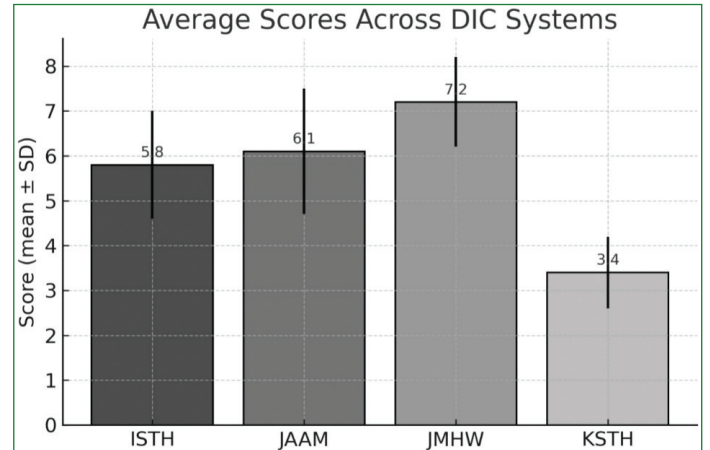
[Table/Fig-5]: Proportion of patients classified as overt DIC, mean±SD scores, and diagnostic accuracy metrics-including area under the ROC curve (AUC), sensitivity, specificity, and p-values- for the ISTH, JAAM, JMHW, and KSTH scoring systems.

The ROC curves comparing the prognostic performance of the ISTH, JAAM, JMHW, and KSTH criteria for mortality prediction are shown in [Table/Fig-6]. The ISTH scoring system demonstrated the highest discriminative ability (AUC=0.84), followed by JAAM (AUC=0.80) and KSTH (AUC=0.76), while the JMHW system showed comparatively lower predictive accuracy (AUC=0.72). These differences highlight variation in the sensitivity and specificity of the scoring systems for outcome assessment in critically ill patients.



[Table/Fig-6]: ROC curves for mortality prediction using four DIC scoring systems.

A bar graph illustrating the mean±SD scores generated by the ISTH, JAAM, JMHW, and KSTH scoring systems is presented in [Table/Fig-7]. The ISTH and JAAM systems showed similar average scores (5.8±1.2 and 6.1±1.4, respectively), while the JMHW system produced the highest mean score (7.2±1.0), reflecting its more stringent thresholds. The KSTH system yielded the lowest mean score (3.4±0.8), indicating a narrower diagnostic range. The observed variation underscores inherent differences in scoring calibration and their potential impact on DIC classification in critically ill patients.



[Table/Fig-7]: Mean DIC scores across four diagnostic criteria.

Collectively, these findings establish the ISTH scoring system as the most robust framework for DIC diagnosis in ICU settings, with JAAM and KSTH providing complementary early detection. Integration of ATIII measurement with validated scoring systems enhances assessment of disease severity and risk of progression, while RDW offers minimal incremental prognostic value.

DISCUSSION

In the present prospective ICU study, DIC was characterised by thrombocytopenia, prolonged PT and aPTT, elevated D-dimer levels, and reduced ATIII activity, consistent with systemic coagulation activation and consumption of natural anticoagulants. Among the diagnostic tools evaluated, the ISTH scoring system identified the highest proportion of overt DIC cases, reaffirming its reliability as the reference standard in critically ill patients.

The JAAM and KSTH criteria demonstrated comparable performance, particularly for early recognition, whereas the JMHW score tended to detect disease at later stages. These findings align with previous multicentre validation studies showing that the ISTH score provides superior specificity for overt DIC, while JAAM and related Japanese criteria offer greater sensitivity for early sepsis associated coagulopathy [7,10,11,32].

Correlation analysis revealed significant associations between ISTH scores and conventional coagulation parameters. Prolonged PT and elevated D-dimer levels correlated positively with disease severity, while platelet count and ATIII activity showed significant inverse relationships. Declining ATIII levels paralleled increasing ISTH scores, supporting the role of antithrombin depletion as a marker of DIC progression.

These observations are consistent with reports by Iba T et al., and Wada T et al., who identified ATIII reduction as an early indicator of consumptive coagulopathy in sepsis and trauma [5,21,32]. In contrast, RDW, although elevated in several patients, demonstrated only a weak correlation with DIC severity, underscoring its limited discriminative utility in this context.

The findings reinforce the continued diagnostic and prognostic relevance of conventional markers particularly PT, platelet count, and D-dimer while highlighting the added value of adjunctive biomarkers such as ATIII in refining risk assessment and disease staging.

Evidence suggests that DIC is not a single disease entity but a continuum of haemostatic dysfunction influenced by the underlying disorder, host response, and timing of assessment [1,2]. Sepsis remains the most common precipitating factor in ICU settings, and several scoring systems have been validated specifically for this context. The SIC score proposed by Iba T et al., offers a simplified framework for early identification of coagulopathy aligned with revised sepsis definitions [3,8].

While SIC and JAAM systems are more sensitive for early-stage detection, they may overestimate DIC incidence compared with ISTH, which remains more specific for overt consumptive stages [11,15,16]. The present study supports this distinction, as ISTH scores better aligned with biochemical markers of advanced coagulopathy, whereas JAAM identified additional early-phase cases with milder laboratory abnormalities.

Antithrombin depletion was a consistent finding and an independent correlate of disease severity in the present cohort, mirroring global data on its prognostic significance [21,23]. Although observational and interventional studies have associated low ATIII levels with increased mortality and organ dysfunction, routine supplementation has produced mixed results [22,29]. Meta-analyses suggest potential benefit in selected subgroups with profound deficiency when therapy is initiated early and bleeding risk is low.

The negative correlation between ATIII activity and ISTH scores observed in this study highlights its value for dynamic monitoring and risk stratification. Incorporating ATIII into diagnostic algorithms may enhance detection of progressive coagulopathy, particularly in resource equipped tertiary care settings.

In contrast, RDW a routinely available haematological parameter showed poor correlation with DIC severity in this cohort, despite previous studies linking elevated RDW to worse outcomes in sepsis and multiorgan dysfunction [25-28]. Indian studies have similarly reported its prognostic utility in septic and Coronavirus Disease of 2019 (COVID-19) populations [33-35]. However, RDW's non-specific nature, influenced by inflammation, nutritional status, and erythropoietic stress, limits its standalone diagnostic value in DIC.

The present findings suggest that while RDW may complement inflammatory markers in overall prognostication, it lacks the specificity required for identifying consumptive coagulopathy.

Internationally, the performance of diagnostic criteria for DIC has been extensively compared across clinical settings, including trauma, obstetrics, and sepsis [6,14,18-20]. Trauma-Induced Coagulopathy (TIC) presents early with hypocoagulability and hyperfibrinolysis driven by shock and tissue injury, whereas trauma associated DIC evolves later with a shift toward fibrin deposition and factor consumption [6,20].

Similarly, obstetric DIC has distinct pathophysiological features particularly hypofibrinogenaemia which serves as a sentinel marker of severity in peripartum haemorrhage and placental abruption [17,18]. Although the present study primarily included medical ICU patients, the findings align with the principle that diagnostic scoring must be contextualised according to the underlying aetiology and that serial assessment provides greater clinical insight than single-point evaluation.

The results also support the pragmatic conclusion drawn from comparative analyses that ISTH scoring offers optimal specificity for overt DIC, while JAAM and KSTH criteria enhance early detection. Combining these structured diagnostic systems with targeted biomarkers such as ATIII may improve both the timeliness and accuracy of DIC recognition. This approach is consistent with large registry-based experiences from Japan and Korea demonstrating improved outcomes with systematic DIC screening and early intervention [11,32,36].

From an Indian perspective, the present findings contribute to a growing but still limited body of data on DIC in critically ill patients.

The clinical heterogeneity of DIC across underlying conditions has been well demonstrated by Dixit A et al., who reported a high burden of severe coagulation abnormalities in patients with acute leukaemia at both presentation and during induction therapy, highlighting the aggressive course of malignancy-associated DIC. Their work also emphasised the critical importance of early recognition using structured diagnostic criteria, aligning with our observation that sensitive scoring systems such as JAAM facilitate timely detection and targeted supportive care in critically ill patients [31].

Venugopal A highlighted the importance of standardised diagnostic criteria and rational transfusion practices in Indian ICUs [37]. More recently, studies by Kapoor M et al., and Jandial A et al., explored the predictive value of DIC and SIC scores, as well as RDW, in sepsis and COVID-19-related coagulopathy, while Jain K et al., and Havaladar AA demonstrated the feasibility of integrating simple haematological indices for prognostication [33-35,38].

However, multicentre validation studies remain scarce, and there is a clear need for larger prospective datasets to evaluate the applicability of global criteria such as ISTH and JAAM within Indian healthcare frameworks, where laboratory and therapeutic resources vary widely.

Therapeutically, integrating structured scoring systems with biomarker-based risk assessment offers opportunities for timely and targeted interventions. Patients identified early through sensitive criteria such as JAAM or SIC may benefit from intensified supportive care, infection control, and closer monitoring, while those meeting ISTH criteria could be prioritised for adjunctive therapies or clinical trial enrolment.

Although ATIII measurement is not universally available, it may serve as a valuable adjunct for identifying high-risk cases. Cost-effective markers such as RDW and platelet trends can be incorporated into pragmatic screening algorithms in settings where advanced testing is limited.

Limitation(s)

The limitations of the present study include its single-centre design and the absence of serial follow-up beyond ICU stay, which precluded assessment of long-term outcomes. Nevertheless, the observed correlations between established scoring systems, classical haemostatic indices, and ATIII activity support the validity of these markers in the Indian ICU setting and provide a foundation for future multicentric research.

CONCLUSION(S)

In the present prospective ICU study, the ISTH scoring system proved to be the most reliable tool for diagnosing DIC, while JAAM and KSTH demonstrated greater sensitivity for early detection. Classical coagulation parameters- platelet count, PT, and D-dimer remained strong indicators of disease severity, whereas fibrinogen contributed less to prognostic assessment.

ATIII activity showed a clear inverse correlation with DIC severity, supporting its value as an important adjunctive biomarker. RDW, despite its accessibility, displayed limited specificity and offered minimal diagnostic utility.

These findings emphasise the benefit of combining validated scoring systems with selective biomarker evaluation to improve diagnostic accuracy and risk stratification. They also add to the limited Indian data on DIC and highlight the need for larger multicentric studies to validate scoring systems and explore the therapeutic potential of AT supplementation in critically ill patients.

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