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Clinico-Epidemiological Predictors and Modified SOFA Score in Assessing the Severity of Dengue in Hospitalized Children

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ABSTRACT

Introduction: Dengue represents a systemic viral infection characterized by a broad clinical spectrum, encompassing presentations from self-limiting febrile episodes to severe, potentially fatal complications. In the absence of targeted antiviral treatment, prompt recognition of pediatric patients predisposed to severe manifestations of dengue remains essential for effective clinical management.

Aim: This study evaluated the utility of clinico-epidemiological parameters, selected laboratory markers, and the modified Sequential Organ Failure Assessment (mSOFA) score in predicting disease severity and outcomes in hospitalized children with dengue.

Materials and Methods: This prospective observational investigation was carried out across 18 months at a tertiary-level teaching hospital located in Eastern India. Children aged 1 month to 12 years with confirmed dengue infection (NS1 antigen and/or IgM positivity) were included. Patients were classified as Dengue Fever ± Warning Signs or Severe Dengue according to the WHO 2009 criteria. Clinical features, laboratory parameters, and admission mSOFA scores were compared between groups. Correlation between mSOFA score and WHO dengue severity classification was assessed using ROC curves.

Results: Altogether, 196 children were incorporated into the analysis; fever was present in all cases. Common symptoms included vomiting (40.9%) and abdominal pain (21.9%), neither of which predicted disease severity except mucosal bleeding ($p < 0.05$). Patients experiencing severe dengue demonstrated a statistically significant decline in platelet counts and higher lactate, SGPT, and serum ferritin levels (mean ferritin: 473.36 vs 250.96 ng/mL; $p < 0.05$). ESR and serum triglycerides were not predictive. The mSOFA score showed a strong positive correlation with dengue severity, with an area under the curve (AUC) of 0.68. All fatalities had mSOFA scores >10.

Conclusion: Thrombocytopenia, elevated SGPT, lactate, and serum ferritin are useful predictors of severe dengue in children, whereas common presenting symptoms have limited

prognostic value. The mSOFA score correlates strongly with established dengue severity classification and may serve as a practical prognostic tool in resource-limited settings.

Keywords: Dengue, Severity, Children, Predictors, mSOFA, Peadtrics

INTRODUCTION

Dengue is a mosquito-borne viral illness present worldwide, with the highest burden in Southeast Asia and other tropical regions.[1] Transmitted primarily by *Aedes aegypti*, dengue affects an estimated 50–100 million individuals annually, nearly half of whom are living in resource-constrained regions. The dengue virus (DENV), a positive-sense single-stranded RNA virus of the *Flaviviridae* family, exists as four distinct serotypes (DENV-1 to DENV-4).

While most infections are asymptomatic or self-limiting, a subset of unfortunate patients, especially children, progress to severe disease characterized by plasma leakage, bleeding, shock, and multiorgan dysfunction.[2] Disease severity is influenced by complex host-virus immune interactions, prior dengue exposure, and viral virulence. The critical phase mostly coincides with the defervescence stage, when capillary permeability increases and clinical deterioration occurs.[3,4,5]

Current dengue management remains largely supportive, emphasizing early recognition of severe disease and judicious fluid therapy.[6] Present WHO classification identifies warning signs and syndromic patterns but does not fully capture evolving multiorgan dysfunction.[7,8] Composite scoring systems such as the Sequential Organ Failure Assessment (SOFA) score, originally developed for sepsis, offer a quantitative approach to severity assessment.[9] The modified SOFA (mSOFA), which relies on easily obtainable clinical and laboratory parameters, may be particularly useful in paediatric dengue, especially in resource-constrained settings.[10]

Hyperinflammatory states such as macrophage activation syndrome (MAS) have been implicated in severe dengue. Biomarkers, including serum ferritin, lactate, albumin, triglycerides, and inflammatory markers, may aid early risk stratification, though their prognostic value in children remains incompletely defined.[7,11,12,13] This observational study was therefore undertaken to assess the utility of these parameters along with the mSOFA score in predicting dengue severity and outcome in hospitalized paediatric patients.

MATERIALS AND METHODS

Study Design and Setting

This prospective observational investigation was carried out across 18 months at a tertiary-level teaching hospital located in Eastern India.

Study Population

Children between 1 month and 12 years of age who were hospitalized with laboratory-confirmed dengue infection, established by NS1 antigen and/or dengue IgM positivity, were included as eligible participants. Written informed consent was obtained from caregivers.

Exclusion Criteria

Children with coexisting acute infections, chronic systemic illnesses, or conditions likely to confound dengue-related complications were excluded.

Sample Size

Bhavsar A et al,[14] found in their study that the proportion of dengue among Indian children was 11.9%, so for this study, p=0.119. Daniel's formula was applied to derive the appropriate sample size for the investigation.

$$n = \frac{Z^2 \times p \times q}{d^2}$$

Where:

- n = sample size
- Z = standard normal deviate at 95% confidence level (1.96)

- p = expected prevalence of dengue among Indian children (11.9%)
- q = 1 − p
- d = allowable error (0.05)

Substituting the values into the formula, the calculated minimum sample size was 161.09. To account for an anticipated 10% attrition rate due to factors such as dropout or leave against medical advice, the sample size was adjusted to 178 children, which was considered the minimum required sample size for the study.

During the course of data collection, a total of 196 eligible children fulfilling the inclusion criteria were enrolled. Since this number exceeded the calculated minimum sample size, all eligible cases were included in the final analysis. Inclusion of a larger sample enhanced the statistical power, precision of estimates, and reliability of the study findings, without affecting the validity of the sample size assumptions.

Data Collection

Detailed demographic data, clinical features, and laboratory investigations were recorded at admission. Patients were classified into Dengue Fever ± Warning Signs and Severe Dengue using the WHO 2009 guidelines.

mSOFA Scoring

The mSOFA score was calculated at admission using SpO_2/FiO_2 ratio (FiO_2 assumed as 0.21 for room air), Glasgow Coma Scale, blood pressure, presence of scleral icterus or jaundice and serum creatinine.

Statistical Analysis

Data were analyzed using SPSS version 27. Continuous variables were compared using independent t-tests and categorical variables using chi-square tests. Correlation between mSOFA score and WHO dengue severity was assessed using the ROC curve.

RESULTS

In our study, 6 (3.06%) patients were ≤1 year of age, 76 (38.8%) patients were 1-5 years of age, 76 (38.8%) patients were 6-10 years of age, and 39 (19.89%) patients were 11-12 years of age (Table 1).

Table 1: Distribution of Age

Age	Frequency	Percent
≤1	6	3.06
1-5	76	38.8
6-10	76	38.8
11 to 12	39	19.89
Total	196	100

A total of 67 (34.2%) patients were female, and 129 (65.8%) patients were male, with a ratio of 1.92: 1 (Table 2).

Table 2: Distribution of Sex

Sex	Frequency	Percent
Female	67	34.2
Male	129	65.8
Total	196	100

Table 3 indicates that a total of 196 children were observed. The most common presenting complaint at admission was fever, documented in all patients. Vomiting was reported in 80 children (40.85%), while 43 (21.94%) experienced abdominal pain. Cough and cold were noted in 35 patients (17.85%), and loose stools were present in 25 (12.75%). In addition, a small proportion of patients presented with rash, convulsions, or mucosal bleeding (Figure 1).

Table 3- Distribution of Clinical Features

Fever	196	100 %
Cough and cold	35	17.85 %
Abdominal pain	43	21.94 %
Vomiting	80	40.85 %
Loose stool	25	12.75 %
Rash	9	4.59 %
Epistaxis	4	2.04 %
Convulsion	3	1.53 %

Note: The total number of complaints (199) exceeds the study population (196) because several children presented with multiple overlapping symptoms at admission.

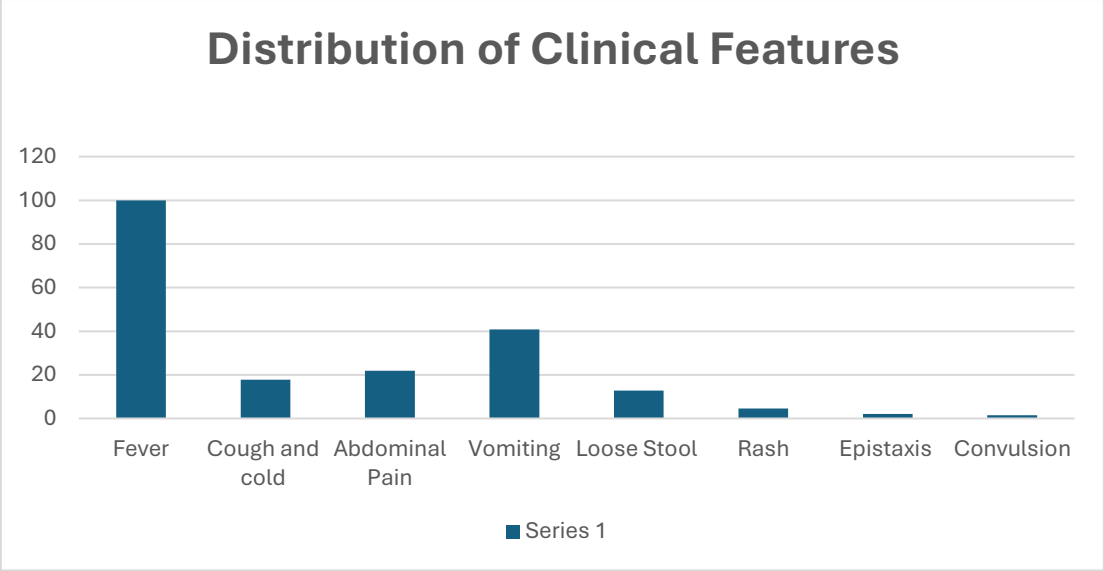

Figure 1: Distribution of clinical features

We observed no significant differences in the clinical presentations—including abdominal pain, vomiting, loose stools, cough and cold, rash, and convulsions—between patients who later progressed to severe dengue and those who did not (Table 4). This suggests that these complaints at admission cannot be considered prognostic indicators for disease severity. In contrast, patients presenting with mucosal bleeding at admission were significantly more likely to progress to severe dengue ($p < 0.05$). This observation implies that initial complaints at hospital presentation cannot be considered prognostic indicators for disease severity.

Table 4: Distribution of clinical features in patients with dengue fever ± warning signs and severe dengue

Characteristics	Total	Dengue Fever ± Warning Signs	Severe Dengue	*p- value*
Pain abdomen	43	36	7	0.433
Vomiting	80	67	13	0.223
Loose stool	25	23	2	0.579
Cough and cold	35	32	3	0.577
Rash	9	6	3	0.058
Convulsion	3	2	1	0.282
Epistaxis	4	0	4	<0.001

Results highlighted that 104 (53.3%) patients had CRP non-reactive, and 91 (46.7%) patients had Reactive CRP. The value of p is .1902. The result is not significant at $p < .05$. On analysis, laboratory parameters such as a fall in platelet count ($p < 0.05$), elevated lactate ($p < 0.05$), and raised SGPT ($p < 0.05$) were observed more frequently in patients with severe dengue compared to those with dengue fever ± warning signs. In contrast, raised serum triglyceride levels were noted in both DF ± warning signs and severe dengue patients, but this parameter did not predict disease severity ($p = 0.533$). Similarly, elevated ESR was observed in both groups ($p = 0.18$), and was not useful in distinguishing severity.

Severe dengue is understood to manifest primarily as an exaggerated immune response rather than a direct viral effect. In this context, we evaluated the correlation of serum ferritin with disease severity. The mean serum ferritin level in patients with Severe Dengue was 473.36 ng/ml, compared to 250.96 ng/ml in patients with DF ± warning signs. This difference was statistically significant ($p < 0.05$).

Table 5: Distribution of lab parameters in patients with dengue fever ± warning signs and severe dengue

Dengue Fever ± Warning Signs			Severe Dengue		
	Mean *(n 171)*	**SD**	**Mean *(n 25)***	**SD**	***p*-value**
TPC *(cell count/µl)*	205283.6257	107064.672	64760.00	23707.031	*p< 0.05*
Ferritin *(ng/ml)*	250.955	194.755	474.360	323.103	*p <0.05*
Lactate *(mmol/L)*	0. 9450	0. 22157	1.4060	.95911	*p<0.05*
ESR *(mm/hr)*	19.1579	11.43234	18.3600	6.04759	*p 0.18*
Albumin *(gm/dL)*	3.2906	.43145	3.2480	63056	*p 0.02*
Triglyceride *(mg/dL)*	185.0643	69.47900	206.0800	101.56276	*p .533*
SGPT *(IU/L)*	50.7135	50.7135	133.0400	133.0400	*p<0.05*

Currently, there is no established scoring system to predict outcomes in paediatric dengue patients. In our study, we evaluated the utility of the modified Sequential Organ Failure Assessment (mSOFA) score for this purpose. The mSOFA score was calculated at the time of admission. SpO_2 was recorded using a pulse oximeter; for patients not requiring supplemental oxygen, FiO_2 was taken as 0.21. Glasgow Coma Scale (GCS) was assessed on admission, blood pressure was measured, and relevant laboratory investigations were performed.

The mSOFA score was then correlated with the WHO dengue severity classification 2009 and divided into two groups: Dengue Fever ± Warning Signs and Severe Dengue. Statistical analysis using the Area Under Curve was done using SPSS 27. ROC curve analysis demonstrated that the Modified SOFA score had a fair ability to predict severe dengue, with an area under the curve (AUC) of 0.68.

The ROC curve lay consistently above the line of no discrimination, indicating that higher mSOFA scores were associated with increased risk of severe dengue. A lower cut-off value of mSOFA ≥1 showed better sensitivity and may be useful for early risk stratification at admission.

Table 6: Diagnostic Performance of Modified SOFA Score for Predicting Severe Dengue

Parameter	Value
Total patients	196
Severe dengue (WHO 2009)	25 (12.8%)
Non-severe dengue	171 (87.2%)
Area under ROC curve (AUC)	0.68

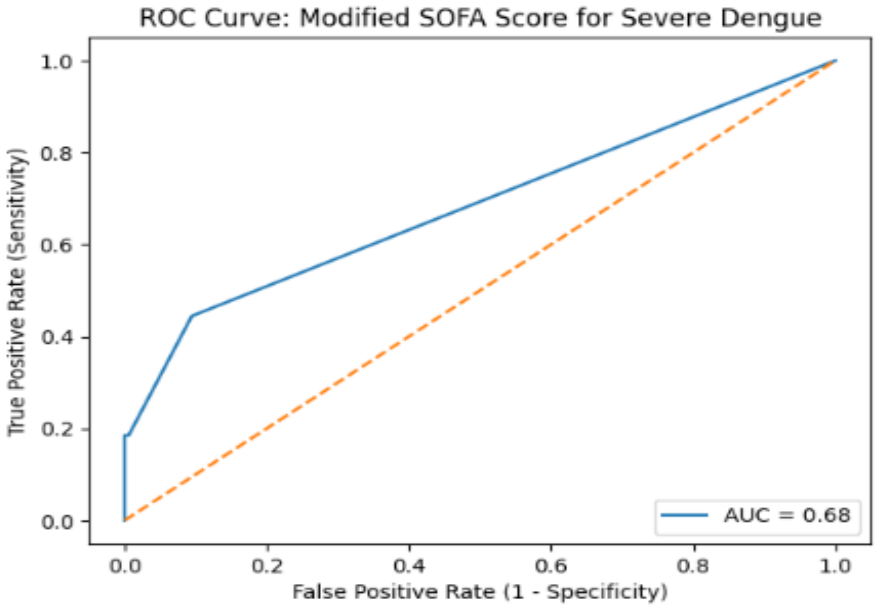

Figure 2: ROC Curve – Modified SOFA score for Severe Dengue

Table 7: Diagnostic accuracy at mSOFA ≥1

Measure	Estimate
Sensitivity	44.4%
Specificity	90.5 %
Positive Predictive Value (PPV)	42.9%
Negative Predictive Value (NPV)	91.1%

DISCUSSION

Dengue persists as a pressing public health issue in tropical climates, particularly in low-resource settings such as India. Diagnosis and prediction of disease progression remain difficult due to its variable clinical presentation and the absence of specific antiviral therapy. Our prospective observational study sought to evaluate the prognostic value of clinical and laboratory features, along with the modified Sequential Organ Failure Assessment (mSOFA) score, in paediatric dengue cases.

The male predominance observed in our cohort (male-to-female ratio 1.92:1) mirrors findings by Puja Rao et al.,[13] who also reported a higher incidence in males, possibly attributable to greater outdoor exposure. Fever was universally present, followed by vomiting (40.85%), abdominal pain (21.94%), and respiratory symptoms such as cough and cold (17.85%). These findings are consistent with the clinical profile described by Keyur D. Mahajan and Rajan Joshi in paediatric populations.[15]

Despite their frequency, presenting complaints such as vomiting, abdominal pain, loose stool, or rash did not significantly correlate with progression to severe dengue. This supports Mahajan and Joshi's conclusion that while these symptoms are common, they lack predictive value for disease severity. In contrast, mucosal bleeding demonstrated a statistically significant association with severe dengue ($p < 0.05$), underscoring its importance as an early warning sign.

The diagnostic utility of inflammatory markers such as C-reactive protein (CRP) remains controversial. In our cohort, CRP was reactive in 46.7% of patients, but this did not reach statistical significance in predicting severity ($p = 0.1902$). This contrasts with findings by Ranjit et al.,[16] who reported higher CRP values in severe dengue. Differences may reflect variations in CRP measurement methods (quantitative vs. qualitative) or population heterogeneity.

Laboratory parameters, including thrombocytopenia, elevated lactate, and raised SGPT, were significantly more common in severe dengue cases ($p < 0.05$ for all), consistent with the systematic review by Sangkaew et al.[17] Conversely, elevated serum triglycerides and ESR lacked predictive value in our cohort, aligning with their limited utility reported in prior studies.

Serum ferritin, a marker of hyperinflammation and macrophage activation syndrome (MAS), was significantly elevated in severe dengue patients (mean: 473.36 ng/ml vs. 250.96 ng/ml in Dengue Fever ± Warning signs, $p < 0.05$). This finding reinforces the utility of ferritin as a prognostic indicator, in line with Chaiyaratana et al.,[18] who suggested a cutoff of ≥1200 ng/ml for severe dengue in adults. Although our mean values were lower, the statistically significant difference reinforces ferritin's relevance in paediatric populations.

ROC curve analysis demonstrated that the Modified SOFA score had a fair discriminatory ability for predicting severe dengue, reflected by an AUC value of 0.68. At a cut-off value of mSOFA ≥1, the score demonstrated high specificity (90.5%) and negative predictive value (91.1%), though sensitivity was modest (44.4%). This suggests that a low mSOFA score at admission effectively rules out severe dengue, whereas higher scores identify a subset at increased risk.

Despite these promising results, it is important to acknowledge that mSOFA has primarily been validated in adult ICU populations. Paediatric adaptations require further multicentre validation. Nevertheless, its simplicity, reproducibility, and strong correlation with dengue severity highlight its potential utility in outbreak scenarios.

The high specificity (90.5%) and NPV (91.1%) at mSOFA ≥1 suggest that children presenting with a score of 0 are unlikely to progress to severe dengue, making the score

particularly useful in early triage, identifying low-risk patients and optimizing resource utilization in high-burden settings

However, the modest sensitivity (44.4%) indicates that mSOFA alone should not be used as a screening tool to detect all severe cases and must be interpreted alongside clinical warning signs.

Previous studies evaluating severity scores in pediatric dengue have shown variable performance[19,20,21], with AUC values ranging from moderate to good depending on the components included. Unlike dengue-specific scores, the Modified SOFA score assesses organ dysfunction, which may occur later in the disease course, explaining its lower sensitivity at admission.

Nevertheless, its objectivity, ease of calculation, and dependence on readily obtainable clinical variables support its utility as a pragmatic bedside instrument in settings with constrained resources.

CONCLUSION

Dengue remains a major paediatric health concern in resource-limited settings. In our study, common presenting complaints lacked predictive value for severity, while mucosal bleeding was significantly associated with DHF. Laboratory markers such as thrombocytopenia, elevated lactate, SGPT, and serum ferritin correlated with severe disease, whereas triglycerides and ESR did not. The mSOFA score showed a strong correlation with the WHO severity classification, and higher scores were linked to increased morbidity and mortality. Owing to its reliance on simple clinical parameters, mSOFA offers a practical tool for prognostic evaluation in paediatric dengue, especially during outbreaks.

Clinical significance

Our study highlights that while common presenting symptoms such as vomiting, abdominal pain, or rash lack prognostic value, mucosal bleeding, thrombocytopenia, elevated lactate, raised SGPT, and serum ferritin are significant predictors of severe dengue in children. Importantly, the modified SOFA (mSOFA) score demonstrated strong correlation with disease severity and mortality, underscoring its utility as a simple, reproducible, and predominantly clinical tool for early risk stratification in resource-limited settings. These findings support the incorporation of mSOFA and select laboratory markers into paediatric dengue management protocols to improve early identification of high-risk cases and optimize outcomes

Declaration By Authors

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Conflict of Interest: The authors declare no conflict of interest.

REFERENCES

1. Murugesan A, Manoharan M. Dengue Virus. In: Emerging and Reemerging Viral Pathogens. Elsevier; 2020. p. 281–359.
2. Chan M, Johansson MA. The incubation periods of Dengue viruses. PLoS One. 2012;7(11): e50972.
3. Kalayanarooj S. Clinical manifestations and management of Dengue/DHF/DSS. Trop Med Health. 2011;39(4 Suppl):83–7.
4. Kularatne SA, Dalugama C. Dengue infection: Global importance, immunopathology and management. Clin Med (Lond). 2022;22(1):9–13.
5. Sarkar A, Taraphdar D, Chatterjee S. Molecular typing of dengue virus circulating in Kolkata, India in 2010. J Trop Med. 2012; 2012:1–6.
6. Mishra S, Ramanathan R, Agarwalla SK. Clinical profile of dengue fever in children: a study from Southern Odisha, India. Scientifica. 2016; 2016:1–6.
7. Chen CM, Chan KS, Yu WL, et al. Outcomes of patients with severe dengue admitted to intensive care units. Medicine (Baltimore). 2016;95(31): e4376.
8. van de Weg CA, Huits RM, Pannuti CS, et al. Hyperferritinaemia in dengue virus infected patients is associated with immune activation and coagulation disturbances. PLoS Negl Trop Dis. 2014;8(10):e3214.
9. Grissom CK, Brown SM, Kuttler KG, et al. A modified sequential organ failure assessment score for critical care triage.

Disaster Med Public Health Prep. 2010;4(4):277–84.
10. Sarker R, Roknuzzaman ASM, Haque MA, et al. Upsurge of dengue outbreaks in several WHO regions: Public awareness, vector control activities, and international collaborations are key to prevent spread. Health Sci Rep. 2024;7(4): e2034.
11. Jog S, Prayag S, Rajhans P, et al. Dengue infection with multiorgan dysfunction: SOFA score, arterial lactate and serum albumin levels are predictors of outcome. Intensive Care Med Exp. 2015;3(Suppl 1): A102.
12. Pothapregada S, Kamalakannan B, Thulasingham M. Risk factors for shock in children with dengue fever. Indian J Crit Care Med. 2015;19(11):661–4.
13. Rao P, Basavaprabhu A, Shenoy S, et al. Correlation of clinical severity and laboratory parameters with various serotypes in dengue virus: A hospital-based study. Int J Microbiol. 2020; 2020:6658445.
14. Bhavsar A, Tam CC, Garg S, et al. Estimated dengue force of infection and burden of primary infections among Indian children. BMC Public Health. 2019; 19:1116.
15. Mahajan KD, Joshi R. Correlation of laboratory profile and clinical features in dengue viral illness in the pediatric population: A retrospective analysis. Pediatr Inf Dis. 2023;5(3):71–8.
16. Ranjit S, Kissoon N. Dengue hemorrhagic fever and shock syndromes. Pediatr Crit Care Med. 2011;12(1):90–100.
17. Sangkaew S, Ming D, Boonyasiri A, et al. Risk predictors of progression to severe disease during the febrile phase of dengue: a systematic review and meta-analysis. Lancet Infect Dis. 2021;21(7):1014–26.
18. Chaiyaratana W, Chuansumrit A, Atamasirikul K, et al. Serum ferritin levels in children with dengue infection. Southeast Asian J Trop Med Public Health. 2008;39(5):832–6.
19. Tran LC, Nguyen PM, Nguyen TK, et al. Evaluation of dengue severity scores for shock prediction: A pediatric cohort in the Mekong Delta, Vietnam. Glob Pediatr. 2025; 13:100272.
20. Phakhounthong K, Chaovalit P, Jittamala P, et al. Predicting the severity of dengue fever in children on admission based on clinical features and laboratory indicators: application of classification tree analysis. BMC Pediatr. 2018;18(1):109.
21. Pongpan S, Khamnuan P, Thanatrakolsri P, et al. Derivation of a Simple Risk Scoring Scheme for Prediction of Severe Dengue Infection in Adult Patients in Thailand. Med Sci (Basel). 2025;13(4):244.

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