

Beyond the Anamnesis: Big Data Reveals Rash, Not Bleeding, as the Critical Predictor of Dengue Shock Syndrome

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Abstract

Dengue shock syndrome (DSS) is a critical, life-threatening complication; however, early prediction remains highly challenging. Clinicians historically rely on classic warning signs obtained through subjective anamnesis, such as persistent fever and spontaneous bleeding, to triage patients despite the potential for observational bias. To address this clinical gap, this study aimed to evaluate the objective predictive value of isolated, patient-reported symptoms on the incidence of shock using a large-scale population dataset. A retrospective observational design utilized big data analytics on routine surveillance records from the Banyumas Regional Health Agency, spanning from 2024 to 2025. The analyzed dataset comprised 1,381 patients, and statistical models, including bivariate analyses and logistic regression, were constructed to quantify the association between

individual clinical symptoms and shock outcomes. The findings reveal a striking clinical anomaly: classically feared symptoms, including bleeding and fever, lack significant predictive power for shock deterioration. Conversely, the presence of a rash emerges as a critical clinical indicator; patients presenting with a rash demonstrate a nearly twofold increased risk of progressing to shock (OR = 1.95). Relying exclusively on subjective anamnesis and universal symptom profiles proves unpredictable and insufficient for anticipating severe dengue. Therefore, a rash serves as a crucial early red flag for underlying plasma leakage, mandating healthcare providers to move beyond rigid textbook paradigms and adopt a holistic, adaptive diagnostic approach to optimize patient safety.

Keywords : Dengue Shock Syndrome, Anamnesis, Big Data, Rash, Clinical Triage

INTRODUCTION

Dengue remains a globally significant public health threat, with disease severity ranging from mild, self-limiting febrile illness to life-threatening complications, particularly in endemic regions [1]. Among these complications, Dengue Shock Syndrome (DSS) represents the most severe outcome. DSS is fundamentally driven by acute endothelial dysfunction, which leads to increased vascular permeability and subsequent plasma leakage, the pathophysiological hallmark distinguishing severe from mild dengue presentations [1, 2]. This endothelial-mediated leakage is associated with complex immunopathological mechanisms, including cytokine release, complement activation, and NS1-mediated vascular injury [2, 3].

Given this complex and evolving clinical course, early diagnosis and triage rely heavily on comprehensive anamnesis, detailed clinical history, and symptom reporting to identify warning signs indicative of progression toward severe disease [4, 5]. Classical diagnostic frameworks explicitly incorporate epidemiological context, subjective anamnesis, and clinical examination as foundational tools preceding laboratory confirmation [4]. Although traditionally considered the cornerstone of early clinical assessment, the objective predictive accuracy of these initial symptom reports requires rigorous validation.

The dynamic and heterogeneous progression of dengue makes the early prediction of shock highly challenging, a complexity that is reflected in recent computational modeling efforts [6, 7]. In daily practice, clinicians have historically depended on classic WHO-defined warning signs, such as persistent fever, abdominal pain, mucosal bleeding, and other hemorrhagic manifestations, as primary indicators of impending deterioration [8, 9]. However, growing evidence suggests that this reliance is frequently influenced by observational bias, where dramatic hemorrhagic cases skew clinical judgment. Multicenter studies have highlighted the poor performance and limited predictive accuracy of these classic warning signs in identifying patients who will progress to shock, emphasizing that critical clinical and laboratory abnormalities often become apparent only as the disease progresses rather than at the initial presentation [10].

This clinical predictive gap is compounded by the fact that many prior studies identifying risk factors for severe outcomes have been limited by small sample sizes and retrospective designs [8]. Large-scale predictive modeling efforts emphasize that robust severity prediction requires the integration of complex variables beyond subjective anamnesis alone, as factors such as dyspnea, established plasma leakage, and overt hemorrhage are stronger independent predictors than initial symptom reports [9, 11]. Consequently, a significant gap remains in understanding whether subjective, anamnesis-reported symptoms are sufficiently robust predictors of shock onset when assessed objectively across a large, heterogeneous population dataset.

To address this gap, our study aimed to evaluate the predictive value of patient-reported clinical symptoms on the incidence of shock using a big data approach. By analyzing massive routine healthcare surveillance data, we sought to objectively quantify the association between individual symptoms and shock outcomes. Ultimately, this study aimed to establish the necessity of a holistic diagnostic framework that moves beyond isolated symptom complaints to optimize early triage and patient safety. We hypothesized that relying exclusively on classic symptoms obtained through anamnesis is unpredictable and insufficient for anticipating dengue shock. Furthermore, we hypothesized that specific, often-overlooked constitutional symptoms may serve as stronger early indicators of plasma leakage when evaluated on a large scale.

METHOD

This research utilized a retrospective observational study design employing a big data analytics approach. The dataset was derived from routine hospital surveillance records provided by the Banyumas Regional Health Agency, Central Java, Indonesia, covering the period from 2024 to 2025. The study population included a comprehensive dataset of 1,381 patients, comprising 781 females and 600 males. The primary outcome variable was the incidence of shock, categorized dichotomously (Shock+ and Shock-). The independent variables consisted of demographic characteristics (age and gender) and isolated clinical symptoms obtained from the patients' anamnesis, which included fever, bleeding, headache, weakness, nausea, myalgia, and rash. Data processing and statistical analyses were performed using R-Studio (R version 4.5.1). Descriptive statistics (median, interquartile range, and frequencies) were used to outline the demographic and clinical profiles of the patients. Bivariate analyses were conducted to evaluate the association between individual symptoms and the incidence of shock. The Mann-Whitney U test was applied for continuous variables, while the Chi-Square test was utilized for categorical variables, with Cramer's V used to determine the effect size of significant associations. Finally, a logistic regression model was constructed to quantify the predictive value and calculate the Odds Ratio (OR) of significant symptoms, specifically evaluating the risk trajectory of patients presenting with specific clinical complaints. Statistical significance was established at $p < 0.05$ [\[12\]](#).

RESULT AND DISCUSSION

Demographic Characteristics and Patient Symptom Profiles

Based on the analysis of patient characteristics stratified by gender (Table 1), this study evaluated a total of 1,381 patients predominately by female. The proportion of shock incidence showed no significant gender bias. Most major clinical symptoms, such as fever, headache, weakness, nausea, myalgia, and rash, were evenly distributed between males

and females, with no statistically significant differences. The only symptom demonstrating a significant difference in proportion between genders was bleeding manifestation. These findings confirm that the dataset profile utilized in this study is well-balanced, allowing for the elimination of gender bias in subsequent statistical modeling.

Table 1 Patients symptom characteristics stratified by Gender

Variable	Level / Metric	Female (N=781)	Male (N=600)	Statistical Tests
SHOCK	Shock-	746 (95.5%)	571 (95.2%)	[a] (p=0.858)
	Shock+	35 (4.5%)	29 (4.8%)	
AGE	Median [IQR]	35.6 [26.2-49.6]	37 [25.6-51.3]	[b] (p=0.457)
FEVER	Fever-	35 (4.5%)	26 (4.3%)	[a] (p=0.999)
	Fever+	746 (95.5%)	574 (95.7%)	
BLEEDING	Bleeding-	605 (77.5%)	493 (82.2%)	[a] (p=0.038*)
	Bleeding+	176 (22.5%)	107 (17.8%)	
HEADACHE	Headache-	69 (8.8%)	45 (7.5%)	[a] (p=0.427)
	Headache+	712 (91.2%)	555 (92.5%)	
WEAKNESS	Weakness-	60 (7.7%)	46 (7.7%)	[a] (p=1)
	Weakness+	721 (92.3%)	554 (92.3%)	
NAUSEA	Nausea-	45 (5.8%)	43 (7.2%)	[a] (p=0.343)
	Nausea+	736 (94.2%)	557 (92.8%)	
MYALGIA	Myalgia-	139 (17.8%)	99 (16.5%)	[a] (p=0.575)
	Myalgia+	642 (82.2%)	501 (83.5%)	
RASH	Rash-	532 (68.1%)	430 (71.7%)	[a] (p=0.173)
	Rash+	249 (31.9%)	170 (28.3%)	

Note: Values are Mean (SD) or Median [IQR] for continuous variables, and n (%) for categorical variables. Symbols indicate statistical test used: [a] Non-Parametric (Mann-whitney) | Effect Size: r (Rank-biserial) [b] Chi-Square Test | Effect Size: Cramer's V
Significance levels: * p<0.05, ** p<0.01, *** p<0.001. Generated by R-Studio (R version 4.5.1 (2025-06-13 ucrt)) on October 02, 2026 at 09:27:55

Association of Clinical Symptoms with Dengue Shock Incidence

A categorical analysis was conducted to determine the extent to which isolated symptoms from the anamnesis could be significantly associated with a fatal clinical outcome, namely shock (Table 2). Surprisingly, classic symptoms often considered critical warning signs, such as fever and bleeding, were not significantly associated with the incidence of shock. Other constitutional symptoms, including weakness, nausea, myalgia, and headache, were also not statistically associated with shock. Conversely, rash was the only clinical symptom that was significantly associated with the incidence of shock.

Table 2 Categorical Analysis for Shock and Patients Symptom

Variable_1	Variable_2	Cramers_V	P_Value	Significance
SHOCK	RASH	0.0755	0.001	**
SHOCK	WEAKNESS	0.0442	0.100	ns
SHOCK	MYALGIA	0.0322	0.231	ns
SHOCK	BLEEDING	0.0289	0.283	ns
SHOCK	HEADACHE	0.0223	0.406	ns
SHOCK	FEVER	0.0222	0.408	ns
SHOCK	NAUSEA	0.0082	0.761	ns

Note: Values are Mean (SD) or Median [IQR] for continuous variables, and n (%) for categorical variables.
Chi-Square Test | Effect Size: Cramer's V | Significance levels: * p<0.05, ** p<0.01, *** p<0.001.
Generated by R-Studio (R version 4.5.1 (2025-06-13 ucrt)) on October 02, 2026 at 09:30:44

Proportion of Rash Association with Shock Risk

Figure 1 visually illustrates the proportion of rash presentation in patients with and without shock. In the non-shock group, the prevalence of rash was lower than that in the shock group. However, in the group of patients who progressed to shock, the percentage of those presenting with a rash increased drastically. This comparative analysis confirms the clinical importance of rash as one of the strongest manifestations distinguishing a patient's clinical trajectory toward severe deterioration.

Statistical Modeling of Shock Prediction Based on Anamnesis

To quantify the predictive value of anamnesis for shock, a logistic regression model was constructed (Figure 2). The forest plot clearly demonstrates that rash has an odds ratio (OR) of 1.95 [95% CI: 1.12 - 3.35], indicating that patients presenting with a rash have nearly double the risk of progressing to shock compared to patients without this symptom. Other symptom variables did not demonstrate significance as independent predictors. The fact that symptom anamnesis alone yields an unpredictable profile for classic symptoms (excluding rash) establishes that a diagnosis based solely on clinical interviews is insufficient for anticipating severe outcomes.

Association Analysis: SHOCK vs RASH

Statistical Modelling: Outcome = SHOCK

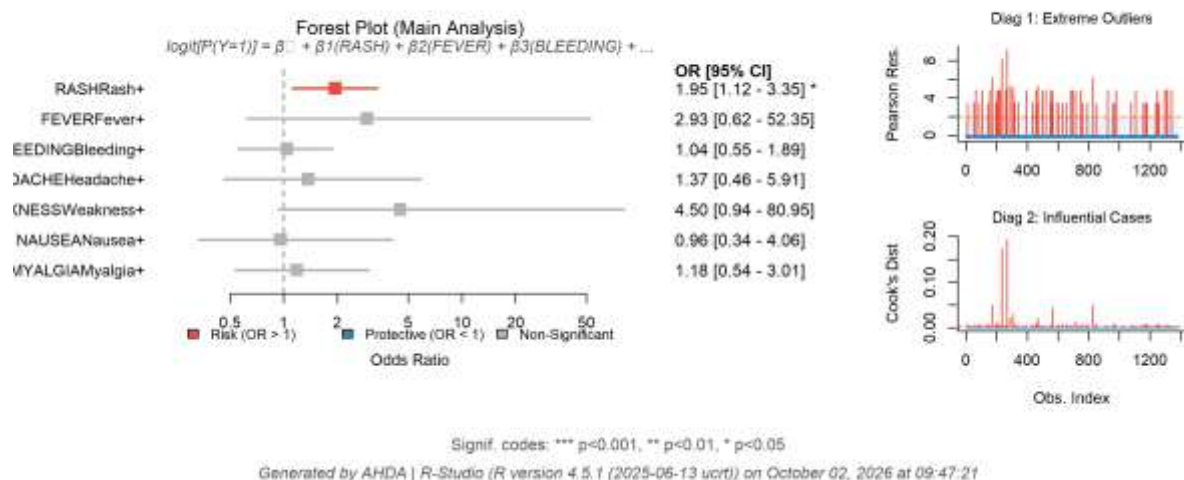


Figure 1 Association between Rash and Shock

Figure 2 Logistic regression for symptoms associated with Shock

A. DISCUSSION

The Uncertainty of Prediction Based on Classic Symptoms

This study reveals a critical clinical anomaly within a large-scale dataset: traditionally feared symptoms, particularly spontaneous bleeding, lack significant predictive power for the occurrence of shock (Table 2). This finding aligns with growing evidence from other large-scale cohorts that directly challenges the entrenched assumption of hemorrhage as the principal harbinger of deterioration. For instance, a multicenter retrospective study on Réunion Island demonstrated that severe dengue cases were primarily driven by multiple organ failure rather than hemorrhagic complications, which remained uncommon despite the majority of patients presenting with thrombocytopenia [13]. Furthermore, the exact pathogenesis of bleeding in dengue remains obscure; even conventional coagulation parameters often fail to differentiate patients who will bleed from those who will not during the critical phase [14]. Universal constitutional symptoms such as fever and generalized weakness are present in over 90% of our study population and are inherently poor discriminators of severity. Because they occur across the vast majority of dengue presentations regardless of the clinical outcome, they function as near-universal entry criteria for both mild and severe disease classifications rather than as distinct predictive markers [15, 16]. Thus, these overly universal symptoms lose their discriminative diagnostic value in early triage.

These findings underscore the reality that the pathophysiological deterioration of dengue into dengue shock syndrome (DSS) is frequently a silent, insidious process. It is not always heralded by hyperacute signs, such as massive bleeding, but rather by massive, initially asymptomatic, plasma leakage. This leakage is primarily a consequence of complex immune mediators rather than overt capillary damage, and overt bleeding is not explicitly required for diagnosing severe plasma leakage-related complications [17, 18]. The subclinical nature of this progression is further reinforced by the findings that occult markers of plasma leakage, such as ultrasonographic evidence of gallbladder wall thickening, often precede visible clinical symptoms and detectable serological changes

[19]. Consequently, relying solely on classic symptomatic presentations is insufficient for anticipating the stealthy clinical trajectory toward shock.

Rash as a Critical Red Flag for Plasma Leakage

One of the most crucial findings in this study is the diagnostic value of the rash, which was strongly associated with shock and carried a nearly twofold increased risk (OR = 1.95) (Figure 2). This observation closely aligns with the established pathophysiological mechanisms of dengue-induced vascular injury. Dengue rash often manifests as petechiae or other hemorrhagic skin presentations that arise from a broader framework of capillary fragility and vascular compromise [20]. Rather than a mere dermatological symptom, this cutaneous finding is a visible, early marker of underlying vascular injury.

Mechanistically, this manifestation reflects profound endothelial dysfunction. Dengue pathogenesis involves both direct and immune-mediated injury to vascular endothelial cells through NS1-driven complement activation, massive cytokine release, and endothelial cell apoptosis processes that severely compromise vascular integrity and barrier function [3]. This resulting endothelial dysfunction is widely recognized as the fundamental driver of increased vascular permeability and subsequent plasma leakage that characterize the progression to dengue shock syndrome (DSS) [21].

Consequently, clinical guidelines increasingly emphasize that cutaneous findings, including rashes, must prompt heightened vigilance for impending vascular compromise, alongside other established warning signs, such as hepatomegaly and mucosal bleeding [22]. Healthcare providers in both primary and advanced facilities are urged to treat the appearance of a rash as a critical clinical cue rather than a benign or incidental finding. If this clinical complaint is overlooked, clinicians may miss the vital window of opportunity to initiate early fluid resuscitation. Failure to recognize this association risks disastrous delays, as the transition from compensated to decompensated hypovolemic shock in dengue can occur with catastrophic rapidity once plasma leakage becomes clinically significant [21, 22].

Limitations of Anamnesis and the Need for Holistic Diagnosis

The results of this study serve as a stark reminder of the danger of relying solely on isolated anamnesis to determine the prognosis of dengue infection. Although it is widely accepted that a comprehensive anamnesis can guide up to 80% of a general clinical diagnosis, the highly dynamic pathogenesis of dengue requires deeper, continuous observation. Patient symptoms and physical examinations alone are insufficiently robust for independent prediction of shock. Multiple predictive modeling studies corroborate this, demonstrating that robust risk stratification for Dengue Shock Syndrome (DSS) requires the integration of dynamic clinical and laboratory parameters rather than static symptom reporting. For instance, a nomogram developed from a large pooled cohort of Southeast Asian children identified that a combination of parameters, including body weight, history of vomiting, liver size, hematocrit levels, and platelet counts, was necessary to achieve strong discriminative performance for DSS, rather than relying on isolated anamnestic complaints [23]. This pattern is consistent across multiple validated models; a scoring system for Indian children identified specific physical and laboratory findings, such as third spacing, tender hepatomegaly, respiratory distress, and aminotransferase elevation, as independent predictors of severe dengue [24].

The temporal trajectory of these clinical markers is critical. A matched case-control study in Vietnam demonstrated that the serial, continuous evaluation of hematocrit and platelet kinetics over time significantly outperformed the use of static warning sign counts in accurately predicting DSS onset [25]. Systematic reviews similarly confirm that the combination of hematocrit elevation with concurrent platelet decline carries a substantially higher predictive value than either parameter assessed in isolation [26]. Advanced machine learning approaches applied to hospitalized cohorts further reinforce that longitudinally assessed biomarkers, including albumin, coagulation parameters, and platelet counts, substantially improve predictive accuracy beyond what clinical history alone can achieve [27, 28].

This body of evidence strengthens the argument that physicians must return to holistic medical principles. It is imperative to integrate the sharpness of a thorough anamnesis with the meticulousness of serial physical examinations and the continuous evaluation of ancillary laboratory parameters. Isolated reliance on patient-reported symptoms is critically inadequate for independently and reliably forecasting the rapid onset of shock.

Validity of Empirical Evidence Through a Big Data Approach

The utilization of big data sourced from routine healthcare facility surveillance is an undeniable strength of this study. This exceptionally large sample size effectively mitigates the observational bias that frequently shapes clinical intuition in daily practice, where a clinician's personal recall may disproportionately rely on memories of dramatic hemorrhagic cases. Large meta-analyses and multicenter cohort studies have repeatedly demonstrated that symptom-severity associations derived from small, single-center case series frequently diverge from patterns observed in broader, heterogeneous populations [29, 30]. For instance, an extensive meta-analysis spanning over 35,000 dengue cases identified 64 candidate predictive factors, yet only roughly half demonstrated consistent, statistically significant associations with severity when pooled across populations [30]. This highlights the inherent risk of drawing definitive prognostic conclusions from limited clinical experience alone [26]. This clinical variability is particularly evident regarding manifestations traditionally viewed as dramatic hallmarks of severity. While clinician recall often overemphasizes bleeding, recent large-scale cohorts demonstrate that despite prevalent thrombocytopenia, hemorrhagic events can remain comparatively uncommon during severe progression [13]. Similarly, the predictive value of mucocutaneous signs like rash has been shown to fluctuate across different global datasets, illustrating that individual clinical observations and anecdotal experiences may not reliably generalize to population-level predictive patterns [31]. The considerable heterogeneity identified across regional studies spanning variations in predictors by age group, serotype, and clinical setting further demonstrates that dengue possesses immense clinical variability [32, 33]. Regional contexts often yield different sets of significant risk factors, rendering rigid

adherence to a universal "textbook" symptom profile inadequate for accurate risk stratification. Ultimately, this big data-driven research sounds a critical alarm for the healthcare system to optimize patient safety and care outcomes; clinical vigilance must not remain rigidly bound to static textbook presentations. Instead, healthcare frameworks must adopt a model of triage and diagnosis that dynamically adapts to continuously updated, population-level data patterns [\[34, 35\]](#).

CONCLUSION

This study demonstrates that relying solely on anamnesis, particularly classic symptoms such as fever and bleeding, is highly unpredictable and insufficient for forecasting the onset of dengue shock. Classic symptoms proved to lack significant discriminative value in a large population dataset. However, the presence of a rash emerged as a critical clinical indicator; patients presenting with a rash exhibited nearly twice the risk of progressing to shock compared to those without this symptom. These findings conclusively answer the research question: patient symptoms alone are inadequate for predicting shock, thereby mandating a return to holistic diagnostic principles. In practice, medical practitioners must elevate their clinical vigilance toward the presentation of a rash in suspected dengue patients. Rather than viewing it as a benign skin manifestation, a rash must be recognized as an early red flag for endothelial dysfunction and plasma leakage, prompting immediate and appropriate fluid resuscitation to prevent irreversible shock. Health policymakers and institutional managers should update clinical pathways and triaging protocols. Standard operating procedures must explicitly mandate a holistic approach that integrates a thorough anamnesis with serial physical examinations and continuous ancillary monitoring (e.g., routine hematocrit and platelet evaluations), rather than allowing clinical decisions to be driven solely by isolated patient complaints.

ACKNOWLEDGEMENT

The authors would like to express their deepest gratitude to the Banyumas Regional Health Agency (Dinas Kesehatan Kabupaten Banyumas), Central Java, Indonesia, for their invaluable support and cooperation in providing access to routine hospital surveillance data from 2024 to 2025. Their commitment to maintaining comprehensive public health records was instrumental in making this study feasible. We also extend our sincere appreciation to the healthcare professionals and administrative staff across the regency, whose diligence in clinical documentation continuously supports the advancement of evidence-based health policies and patient care optimisation

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