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Predictors of Peripheral Intravenous Phlebitis: A Study at a Regional Hospital in Indonesia

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ABSTRACT

Phlebitis is a common complication of peripheral intravenous catheter (PIVC) use that often leads to venous inflammation, pain, and significant disruption of therapy among hospitalized patients. The incidence of phlebitis in patients with PIVCs remains high, frequently exceeding the recommended threshold of ⩽5%, and is associated with adverse clinical outcomes. This study aimed to analyze predictors of peripheral intravenous phlebitis among patients with intravenous fluid devices (IVFDs) at Kotamobagu Regional General Hospital. A quantitative study with a prospective cohort design was conducted in the inpatient wards of Kotamobagu Regional General Hospital from October to December 2025, involving 328 adult patients (⩾18 years) with peripheral IVFDs. Pediatric patients, users of central venous catheters or PICC lines, and uncooperative patients were excluded. The results showed that 29.9% (98 out of 328 patients) had phlebitis Infusion insertion site (OR=4.32; p<0.001) was the most significant factor associated with peripheral intravenous phlebitis, followed by aseptic technique (OR=3.08; p<0.001), type of intravenous fluid (OR=2.14; p=0.003), age (OR=1.21; p=0.041), and sex (OR=1.67; p=0.018). In conclusion, prevention of phlebitis should prioritize appropriate selection of IV insertion sites, strict adherence to aseptic techniques, and careful consideration of the type of intravenous fluids, particularly in patients at higher risk based on age and sex. Non-recommended (distal) insertion sites increase the risk of phlebitis by 4.32 times compared to proximal sites

Key Messages:

- This prospective cohort study identifies the infusion insertion site and adherence to aseptic techniques as the strongest predictors of peripheral intravenous phlebitis, highlighting that targeted clinical protocols focusing on proximal site selection and strict hygiene are critical to mitigating the high incidence of this complication.

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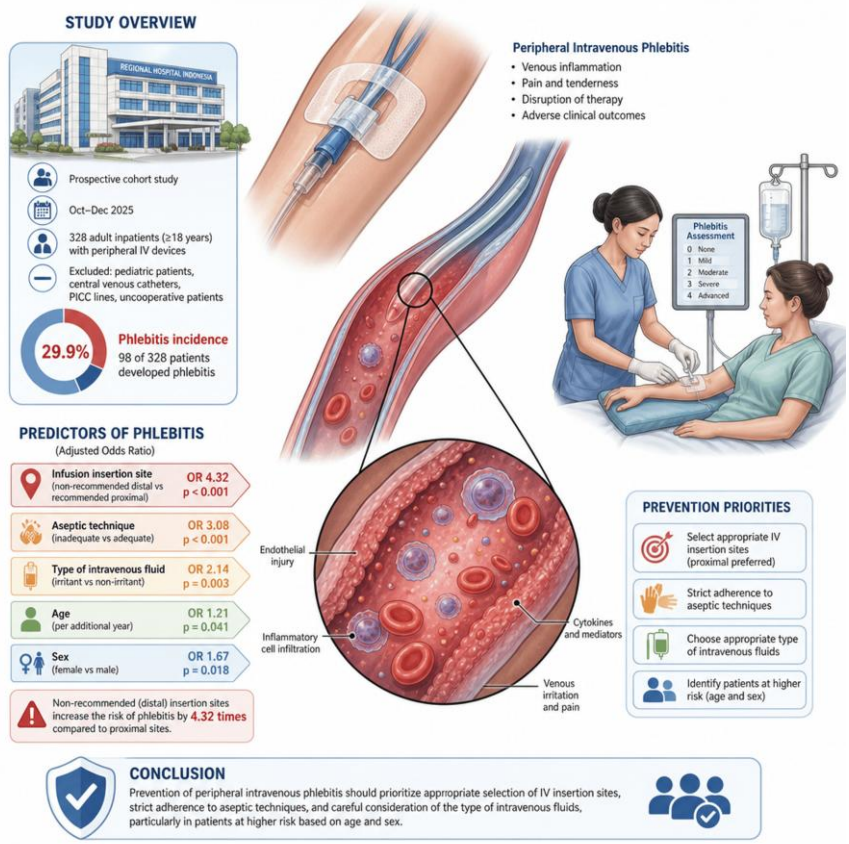
GRAPHICAL ABSTRACT



INTRODUCTION

Phlebitis is a common complication associated with the use of peripheral intravenous catheters (PIVCs), often resulting in venous inflammation, pain, and significant disruption of therapy among hospitalized patients (1). Evidence from meta-analyses indicates that the incidence of phlebitis among PIVC users remains high, frequently exceeding the recommended threshold of ≤5%, with detrimental effects on patient clinical outcomes (2). Intravenous infusion is administered when there is a risk of conditions such as dehydration or anemia, which are closely associated with inadequate balanced nutritional intake .Although intravenous infusion therapy is a routine and essential procedure in hospital care, the persistent occurrence of phlebitis highlights ongoing challenges in daily clinical practice (3). Inadequate identification of risk factors within hospitals and other healthcare facilities contributes to the high incidence of phlebitis, which may prolong hospital stays, increase healthcare costs, and negatively affect patient experiences (4).

Previous studies have identified various risk factors for phlebitis, including catheter dwell time, catheter gauge, and type of infused solution; however, these findings have not been consistent across different clinical settings and patient populations (5). Several studies have reported that phlebitis risk may vary according to patient characteristics such as sex, age, and the number of medications administered intravenously (6). Nevertheless, most available evidence originates from healthcare settings outside Indonesia or from large tertiary hospitals, limiting the generalizability of findings to regional hospitals such as Kotamobagu Regional General Hospital. This gap underscores the need for locally focused research to identify predictors of phlebitis that reflect the unique patient demographics and clinical practices within Indonesian healthcare facilities.

If left unaddressed, phlebitis can progress to more severe complications, including potentially life-threatening bloodstream infections, persistent pain, and interruption of essential intravenous therapy (7). Furthermore, phlebitis has been associated with prolonged length of hospital stay, increased healthcare expenditure, and substantial patient discomfort (8). Although the incidence of other complications such as

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PIVC-related infections may be relatively low, the overall impact of catheter failure including phlebitis remains clinically significant in both nursing and medical practice (9). A more comprehensive understanding of phlebitis predictors is therefore essential to inform evidence-based preventive strategies aimed at reducing this clinical burden (10).

Many previous studies have relied on heterogeneous datasets without adequately accounting for contextual variations, such as differences in nursing training, institutional protocols, and infusion practices across hospitals (11). In addition, most existing phlebitis prediction models have not been extensively validated across diverse clinical settings, raising concerns regarding their external validity (12). Several studies have also overlooked hospital environmental factors and local nursing practices that may directly influence phlebitis incidence. Consequently, research that systematically incorporates local contextual variables is crucial to advancing the understanding of phlebitis predictors.

Methodologically, prior research has often employed descriptive designs without robust multivariate predictive analyses, limiting the identification of independent risk factors for phlebitis (13). The frequent reliance on cross-sectional designs further constrains the ability to infer causal relationships between risk factors and phlebitis occurrence (14). Additionally, many studies have utilized relatively small sample sizes or populations restricted to specialized units such as intensive care units, thereby reducing the generalizability of findings to the broader inpatient population (15). These methodological gaps highlight the need for prospective cohort studies employing stronger statistical approaches to predict phlebitis among patients receiving intravenous fluid devices in general hospital settings (16).

In regional general hospitals such as Kotamobagu, patient clinical dynamics, variations in nursing practices, and demographic profiles may differ substantially from those observed in urban or large academic hospitals that dominate existing literature (17). To date, no comprehensive study has evaluated predictors of peripheral intravenous phlebitis in regional public hospitals in Indonesia, including local risk factors that may contribute to its occurrence (18). This study aims to address this gap by providing empirical evidence on the epidemiology and predictors of phlebitis within a local hospital context. The findings are expected to inform more contextually appropriate and effective preventive strategies for Indonesian healthcare settings (1).

The novelty of this study lies in its focus on evaluating predictors of phlebitis in a regional general hospital using a prospective cohort design and a comprehensive multivariate analytical model, an approach that remains underexplored in previous research. This study simultaneously considers clinical, demographic, and local practice-related variables that may influence phlebitis occurrence (11). Another key contribution is the potential development of a phlebitis risk prediction model adaptable to similar healthcare facilities across Indonesia (19). Ultimately, these findings are anticipated to provide a strong scientific basis for tailored, evidence-based preventive interventions, improve the quality of intravenous infusion care, and reduce preventable complications associated with PIVC use (20).

Based on this background, the present study seeks to identify predictors associated with phlebitis among patients receiving peripheral intravenous infusion therapy. The specific objective of this study is to analyze predictors of peripheral intravenous phlebitis among patients with intravenous fluid devices at Kotamobagu Regional General Hospital.

METHODS

This study employed a quantitative with a prospective cohort design (21) to identify predictor factors associated with the occurrence of peripheral intravenous phlebitis among patients receiving intravenous fluid devices (IVFDs) during hospitalization.

The study was conducted at Kotamobagu Regional General Hospital, specifically in inpatient units where peripheral intravenous catheterization is routinely performed, from October to December 2025. A total of 328 patients with intravenous infusions who met the inclusion criteria were enrolled, namely adult patients aged ≥18 years with peripheral IVFDs. The exclusion criteria included pediatric patients, those with central venous catheters (CVCs) or peripherally inserted central catheters (PICCs), and patients who were uncooperative or demonstrated behaviors such as pulling out or removing medical devices during intravenous therapy. Probability sampling with a simple random sampling method was applied.

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Data collection commenced at the time of peripheral intravenous catheter insertion. Each participant was observed periodically (every shift or at least every 24 hours) to assess signs and symptoms of phlebitis using a validated phlebitis assessment tool, such as the Visual Infusion Phlebitis (VIP) score. Patient characteristics, insertion site, aseptic technique, and type of intravenous fluid were recorded using a structured observation checklist.

Data analysis was performed using IBM SPSS version 27. Descriptive statistics were applied for univariate analysis, the Chi-square test for bivariate analysis, and multiple logistic regression for multivariate analysis, with a significance level set at $p < 0.05$. Ethical approval was obtained from the Health Research Ethics Committee of the Manado Health Polytechnic, Ministry of Health, under approval number IRB-2025-0231.

RESULTS

Based on Tables 1, the majority of respondents had a senior high school education (36.6%), This indicates a predominance of secondary educational backgrounds, which may influence understanding of healthcare procedures and adherence to medical care. The study population was predominantly male (59.1%) and aged under 60 years (64.0%). Most participants had a secondary level of education. Clinically, a considerable proportion of patients experienced phlebitis, with an incidence rate of 29.9%. Regarding procedural factors, variations were observed in infusion insertion sites and adherence to aseptic techniques, which were further analyzed for their association with phlebitis occurrence. The predominance of older adults reflects a respondent profile that may be more vulnerable to medical complications. Regarding employment status, most respondents were farmers (32.3%) and homemakers (25.0%), followed by private-sector employees (15.2%), whereas students represented the smallest group (4.3%). This distribution reflects a socioeconomic context dominated by the informal sector. In terms of sex, male respondents (59.1%) outnumbered females (40.9%), indicating male predominance, which may influence variations in clinical risk.

Table 1. Baseline Characteristics of Participants (n = 328)

Respondent Characteristics/Variables	n	%
Education		
Elementary School	75	22.9
Junior High School	80	24.4
Senior High School	120	36.6
College	53	16.2
Age (year)		
< 60 y.o	210	64.0
≥ 60 y.o	118	36.0
Age Group		
18-29	63	19.2
30-45	40	12.2
46-55	43	13.1
56-65	108	32.9
66-75	60	18.3
>75	14	4.3
Occupation		
Student	14	4.3
Farmer's	106	32.3
Housewife	82	25.0
Civil Servant	20	6.1
Private employees	50	15.2
Retireed	40	12.2
Odd job	16	4.9
Sex		
Male	194	59.1
Female	134	40.9
Infusion insertion site		
Proximal	200	61.0
Distal	128	39.0
Aseptic technique		

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Respondent Characteristics/Variables	n	%
Appropriate	198	60.4
Inappropriate	130	39.6
Type of intravenous fluid		
Non-irritant	247	75.3
Irritant / hyperosmolar	81	24.7
Peripheral Intravenous Phlebitis		
No	230	70.1
Yes	98	29.9

The findings also show that the majority of respondents were aged <60 years (64.0%), while those aged ≥60 years accounted for 36.0%, indicating that most respondents were of productive age despite a substantial proportion of older adults. The sex distribution was consistent with Table 1, with males (59.1%) predominating over females (40.9%). In addition, intravenous catheter insertion was more frequently performed at proximal sites (61.0%) than distal sites (39.0%), suggesting a preference for larger and more stable veins. Most intravenous insertions were performed in accordance with aseptic standards (60.4%); however, 39.6% did not meet aseptic standards, which may increase the risk of complications. Furthermore, most respondents received non-irritant intravenous fluids (75.3%), whereas irritant or hyperosmolar solutions were used in 24.7%, reflecting efforts to minimize vascular irritation. Although the majority of respondents did not develop phlebitis (70.1%), phlebitis was still observed in 29.9% of cases, indicating that peripheral intravenous phlebitis remains a clinical issue requiring attention.

Table 2. Logistic Regression Test of Independent and Dependent Variables

Variable	Category	OR	95% CI	p-Value
Infusion insertion site	Proximal (Ref)	1.00	-	-
	Distal	4.32	2.41-7.32	<0.001
Aseptic technique	Appropriate (Ref)	1.00	-	-
	Inappropriate	3.08	1.78-5.34	<0.001
Type of intravenous fluid	Non-irritant (Ref)	1.00	-	-
	Irritant / hyperosmolar	2.14	1.30–3.53	0.003
Sex	Male (Ref)	1.00	-	-
	Female	1.67	1.21-2.25	0.018

Partially, the infusion insertion site was identified as the most dominant factor associated with peripheral intravenous phlebitis. Patients with infusion sites that were not in accordance with recommended guidelines (distal sites) had a 4.32-fold higher risk of developing phlebitis compared to those with recommended (proximal) sites (OR = 4.32; 95% CI: 2.41–7.74; p < 0.001). Furthermore, the aseptic insertion technique was also significantly associated with phlebitis, where non-adherence to aseptic standards increased the risk by 3.08 times compared to proper aseptic technique (OR = 3.08; 95% CI: 1.78–5.32; p < 0.001). The type of intravenous fluid showed a significant association with peripheral intravenous phlebitis, with the use of irritant or high-osmolarity fluids increasing the risk by 2.14 times (OR = 2.14; 95% CI: 1.30–3.53; p = 0.003). Phlebitis occurred at a mean duration of approximately 30-34 hours following catheter insertion, indicating that the risk increases after the first 24–48 hours of infusion therapy. A more detailed analysis of phlebitis severity using the Visual Infusion Phlebitis (VIP) score revealed that most cases were identified at early stages. However, a proportion of patients progressed to more advanced grades, indicating clinically significant inflammation requiring intervention.

DISCUSSION

Infusion Insertion Site

The findings of this study indicate that the infusion insertion site has the most dominant association with the occurrence of peripheral intravenous phlebitis, with a 4.32-fold higher risk when the catheter is inserted at non-recommended sites compared to optimal sites (p < 0.001). This finding is consistent with existing literature reporting that inappropriate site selection particularly in veins prone to friction or repeated trauma significantly increases the risk of phlebitis due to mechanical irritation and prolonged contact between the catheter and the venous wall (2). Peripheral intravenous catheter

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placement in areas of flexion is more frequently associated with phlebitis, as movement of the extremity causes catheter displacement, leading to repeated trauma to the venous endothelium (21).

These results align with previous studies demonstrating a significant correlation between catheter insertion site and the incidence of mechanical phlebitis, particularly in sites such as the metacarpal veins and flexor areas, which are more susceptible to mechanical stress. Consequently, catheter insertion site selection plays a crucial role in the development of phlebitis (22). Evidence from international studies further supports that insertion sites such as the dorsum of the hand are associated with an increased risk of phlebitis compared to other locations, largely due to mechanical stress on the venous wall during patient movement. This highlights the importance of careful site selection as a key preventive measure against phlebitis (23).

Although some studies have reported no statistically significant differences in phlebitis incidence across insertion sites, the overall trend suggests that peripheral catheter placement should consider extremity mobility and vein caliber, as these factors are interrelated and contribute to phlebitis development. Therefore, catheter insertion site should be incorporated into clinical risk assessment and infusion nursing protocols (24). Supporting this perspective, a large multinational study reported that phlebitis risk varies by catheter location, with insertions near joints such as the wrist or antecubital fossa—being associated with higher complication rates compared to sites such as the forearm or dorsum of the hand, which are relatively less affected by extensive extremity movement (23).

Aseptic Technique

In addition, aseptic technique during intravenous catheter insertion was found to significantly contribute to the occurrence of phlebitis (OR = 3.08; $p < 0.001$). Non-adherence to standard aseptic procedures may lead to skin contamination or microbial introduction and can damage the venous endothelium, thereby increasing local inflammatory responses (25). This finding is consistent with the most recent Infusion Therapy Standards of Practice, which emphasize the critical importance of strict aseptic technique during both insertion and maintenance of intravenous catheters to prevent infectious and inflammatory complicationsi (26). Aseptic technique is a fundamental approach in preventing nosocomial infections, with an estimated 30% of such infections considered preventable through proper implementation (27).

Previous studies have demonstrated that inadequate catheter insertion techniques, including suboptimal aseptic practices, are among the key factors associated with post-infusion phlebitis. Therefore, optimal application of aseptic technique prior to catheter insertion is essential to reduce the risk of phlebitis (28). Nursing interventions aimed at preventing and managing phlebitis focus on the rigorous application of aseptic measures, including proper hand hygiene, the use of clean gloves, appropriate skin antisepsis with chlorhexidine, and ongoing catheter care and intravenous access maintenance accompanied by continuous monitoring for signs of phlebitis (29). Evidence from prior research further reinforces that aseptic non-touch technique during catheter insertion and maintenance is a core component of current recommendations to reduce contamination and local complications such as phlebitis associated with peripheral intravenous catheters (PIVCs) (9). Therefore, improving nurses' skills in aseptic technique is a key evidence-supported strategy to minimize phlebitis in intravenous nursing practice.

Type of Intravenous Fluid

The type of intravenous fluid used was also significantly associated with the occurrence of peripheral intravenous phlebitis (OR = 2.14; $p = 0.003$). Irritant, hypertonic, or extreme-pH solutions tend to cause venous endothelial damage, thereby triggering inflammatory responses and the development of phlebitis. This finding is consistent with evidence from cohort studies indicating that infusion characteristics such as osmolality, pH, and chemical properties are important predictors of catheter-related phlebitis (30). Previous studies have shown that hypertonic solutions, when administered rapidly and in large volumes, may lead to extracellular fluid shifts, circulatory fluid overload, and dehydration. Consequently, the type of infused solution represents a key contributing factor to phlebitis, as higher solution concentrations are associated with an increased risk of phlebitis (31).

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The finding of this study are also in agreement with earlier research demonstrating a significant association between the type of intravenous fluid and phlebitis incidence, with hypertonic and high-osmolality solutions more frequently linked to phlebitis than isotonic fluids. This suggests that the chemical properties of infused solutions induce irritation of the venous wall and enhance endothelial inflammation, thereby increasing the incidence of phlebitis among hospitalized patients (32). Additional evidence from international literature further supports that infusions involving high-osmolality (hypertonic) solutions are more likely to increase phlebitis incidence due to osmotic alterations in the venous wall that damage endothelial cells, compared with isotonic solutions, which are generally better tolerated by the vascular system (33).

Sex

In addition, patient characteristics particularly sex were significantly correlated with the occurrence of phlebitis (OR = 1.67; p = 0.018). This finding supports evidence from meta-analyses indicating that the incidence of phlebitis is often higher in specific patient groups, such as females, although this pattern may vary across populations and clinical settings. Biological differences and variations in immune and vascular responses to endothelial trauma may partly explain these observed differences (34). Age has also been identified as a factor associated with peripheral intravenous complications in hospital settings, as reported in studies conducted in Thailand. Therefore, nurses should pay particular attention to potential complications related to peripheral intravenous fluid administration, especially among older patients and those receiving intravenous crystalloids or analgesic medications (35).

These findings are consistent with previous research on risk factors for peripheral intravenous phlebitis, which has shown that female patients tend to have a higher risk of developing phlebitis compared with male patients. This increased risk may be related to physiological differences, such as smaller vein diameter and hormonal influences that affect vascular reactivity. For example, a meta-analysis of peripheral catheter–related phlebitis reported a significantly higher risk among females (OR = 1.42; p = 0.02) (2). Similarly, a prospective cohort study conducted in Spanish hospitals identified female sex as an independent risk factor for PIVC-related phlebitis. Taken together, the current findings reinforce the evidence that female sex should be considered in phlebitis risk assessment and preventive strategies. However, discrepancies with some studies that reported no significant association highlight the need for context-specific risk assessment approaches in clinical practice.

Age

The analysis also confirmed that age was correlated with the risk of phlebitis, although its effect size was smaller than that of other variables (OR = 1.21; p = 0.041). Increasing age is associated with vascular structural changes, such as reduced venous elasticity and decreased tissue perfusion, which may increase susceptibility to trauma and inflammation during peripheral intravenous catheter insertion (36). This evidence is consistent with findings from large cohort studies demonstrating that age-related factors influence catheter-related complications (37).

The findings further indicate that age significantly contributed to the occurrence of phlebitis among patients with intravenous fluid devices, with certain age groups exhibiting a higher risk than others. This result aligns with previous studies reporting age as a significant determinant of phlebitis incidence. For example, hospital-based research has identified a meaningful association between patient age and phlebitis occurrence (p = 0.041; OR = 1.21), suggesting that patients within specific age ranges are more likely to develop phlebitis compared with other age groups (33).

Consistent with epidemiological studies, variations in phlebitis incidence across age groups have been reported, with some international studies identifying higher incidence rates among patients younger than 60 years, while also noting variability among older populations. These findings suggest that physiological factors and tissue responses to catheter insertion change with aging (38). Collectively, this evidence reinforces the importance of considering patient age in phlebitis risk assessment in clinical practice and highlights the need for further research to elucidate the underlying mechanisms.

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Methodologically, the regression model employed in this study demonstrated stable estimates, as indicated by relatively narrow confidence intervals for significant variables and low variance inflation factor (VIF) values, confirming the absence of multicollinearity (39). However, due to the cross-sectional design, causal relationships cannot be fully established; the observed effects represent associations consistent with the hypothesis that increased phlebitis risk is related to several factors, including catheter insertion site and aseptic technique (40). Therefore, odds ratios should be interpreted as measures of association rather than direct causal effects. Establishing causality would require longitudinal or controlled interventional study designs.

CONCLUSION

The study demonstrated that the infusion insertion site was the strongest predictor of phlebitis, with distal sites significantly increasing the risk compared to proximal sites. In addition, inappropriate aseptic technique and the use of irritant or hyperosmolar intravenous fluids were identified as significant contributing factors. Given the high incidence of phlebitis observed, these findings highlight the urgent need for targeted clinical interventions. Implementing a standardized peripheral intravenous catheter (PIVC) monitoring protocol, including strict adherence to aseptic techniques, appropriate selection of insertion sites, and careful evaluation of infused fluids, is essential to reduce the incidence of phlebitis, improve patient safety, and minimize preventable complications in clinical practic.

DECLARATION OF THE USE OF AI

The authors declare that no artificial intelligence (AI), AI-assisted technologies, or large language models (LLMs) were used in the conception of the study, data analysis, or the drafting, writing, and editing of this manuscript. The only exception is the graphical abstract, which was created using the design platform Illustrae (https://illustrae.co/). The authors take full responsibility for the content and accuracy of the graphical abstract and the entire manuscript.

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CONFLICTS OF INTEREST

The authors declare that there are no conflicts of interest associated with this study.

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