

Severe Malaria at the Samine Health Center in Sédhiou: Current Aspects and Evolving Profile

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ABSTRACT

Introduction: Severe malaria, predominantly caused by *Plasmodium falciparum*, remains a major cause of morbidity and mortality in sub-Saharan Africa. In Senegal, over 10,000 severe cases are reported annually, increasingly affecting both children and adults. This study aimed to describe the clinical and epidemiological characteristics of patients hospitalized for severe malaria at the Samine Health Center.

Materials and Methods: A retrospective, cross-sectional, and descriptive study was conducted from January 1, 2020, to December 31, 2023. All patients hospitalized for severe malaria during this period were included.

Results: Among 411 hospitalized patients, 124 had severe malaria, representing a hospital incidence of 30.17%. Most cases were admitted in 2021 (34.67%) and during October-November, peaking in November (34.68%). The majority were male (66%), with a sex ratio of 1.95. The average age was 18.31 ± 14.68 years, with children aged 5-15 years being the most affected (49.19%). The main symptoms were fever (84.68%), vomiting (58.06%), and headache (56.45%). Severity signs included prostration (79.84%), jaundice (23.39%), and coma (17.74%). Thick blood smear confirmed *P. falciparum* in all cases, with a mean parasitemia of 32,372/ μ L. Severe anemia affected 13.1% of adults and 12.5% of children; thrombocytopenia was observed in 80.77%, and 36.54% had severe forms. Artesunate was used in all cases, followed by ACT, with 23.39% also receiving antibiotics. The average hospital stay was 2.45 days. The outcome was favorable in 91.13% of patients, with no deaths recorded.

Conclusion: This study demonstrates that severe malaria, while frequent, can be effectively managed even in peripheral health structures.

Keywords: Severe malaria; Samine, Senegal

INTRODUCTION

Malaria is a febrile, parasitic infectious disease caused by a blood-borne parasite of the genus *Plasmodium*, transmitted to humans by a female *Anopheles* mosquito vector. It is one of the most widespread endemic and epidemic diseases worldwide, especially in sub-Saharan Africa. Severe malaria remains the major complication of *Plasmodium* infection, causing morbidity and

mortality, especially among children. There has been a significant increase in cases among indigenous adults.

In 2023, the World Health Organization (WHO) estimated that 249 million malaria cases were recorded worldwide, with an incidence of 58.4 million and 608,000 deaths [1]. The WHO African region is the most affected, accounting for 94% of global malaria cases, or 233 million cases, and 95% of all malaria

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Received: 13-Aug-2025, Manuscript No. JADPR-25-38465; **Editor assigned:** 15-Aug-2025, Pre QC No. JADPR-25-38465 (PQ); **Reviewed:** 29-Aug-2025, QC No. JADPR-25-38465; **Revised:** 05-Sep-2025, Manuscript No. JADPR-25-38465 (R); **Published:** 15-Sep-2025, DOI: 10.35841/2329-8731.25.13.407

Citation: Ngom NF, Faye FA, Diop ECA, Mbengue BM, Dia ME, Ndiaye A, et al. (2025). Severe Malaria at the Samine Health Center in Sédhiou: Current Aspects and Evolving Profile. *Infect Dis Preve Med*.13:407.

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deaths, or 580,000 deaths [1]. Malaria poses a major obstacle to development and the improvement of public health.

To combat this disease, the WHO has launched several initiatives, including the Global Technical Strategy for Malaria Control 2016-2030. This strategy aims to reduce malaria mortality and incidence rates by 90% by 2030, eliminate the disease in at least 35 countries where transmission was present in 2015, and prevent the recurrence of malaria in countries already free of the disease [2].

Faced with the emergence of resistance to antimalarial drugs, particularly chloroquine, artemisinin is now the standard treatment, often combined with other drugs in Artemisinin-Based Combination Therapies (ACTs) [3]. New drugs, such as tafenoquine, are also being evaluated to treat various forms of malaria, including resistant malaria [4].

In Senegal, the disease remains endemic with 358,033 confirmed cases of malaria in 2022 and 273 deaths [5]. The report also indicates 10,412 cases of severe malaria, including 1,404 in children under five years of age. There has been an increase in the hospital incidence of severe malaria in adults, from 17% of infections in 2007 [6] to 30.8% in 2010 [7].

Like many countries, Senegal has committed to eliminating malaria by 2030. In 2021, 51 health districts were classified as pre-elimination, with an annual incidence of less than 5 cases per 1,000 inhabitants [8]. The area of very low transmission, which concerns the north of the country, is gradually extending towards the west and the center, while the south remains an area of high transmission.

These advances are primarily the result of two strategies aimed at interrupting malaria transmission in pre-elimination areas. The first, called the Focal Mass Drug Administration (FMDA) Strategy, involves documenting and investigating all malaria cases [8]. The second, the Focal Test and Treat (FTAT) Strategy, also investigates cases but extends the assessment beyond surrounding houses [9].

However, case fatality remains high in hospital settings, ranging from 10.7% to 20.2%, and affects both adults and children [9,10]. Malaria follows a seasonal pattern with increased prevalence during the rainy season [11].

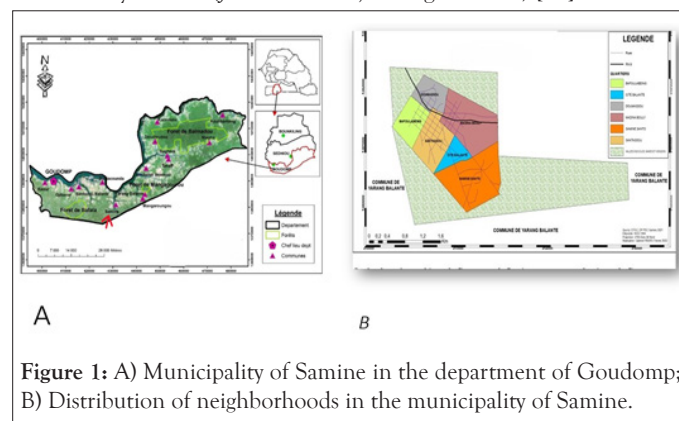
In the context of malaria pre-elimination, it becomes essential to explore the characteristics of the various forms of the disease across regions. This is the perspective of our study, conducted at the Samine Health Center in Sédhiou, a region with annual rainfall of approximately 1,600 mm and an area of very high malaria transmission. The objectives of our study were: To describe the epidemiological, clinical, and paraclinical aspects of severe malaria at the Samine Health Center and to analyze the evolutionary aspects of severe malaria in this facility.

MATERIAL AND METHODS

Study framework

The village of Samine Escale was founded in 1919 by the Balante people from Gabou, a province in the Republic of Guinea-Bissau, who were the first inhabitants of the locality. The name "Samine" or "thieng Yaby" refers to three mangrove trees [12] (Figure 1). By Law No. 2013-10 of December 28, 2013, establishing the General Clearance of Lands (CGCL), Samine became a commune in the Djibanar district of the Goudomp department, within the

Sédhiou region [13]. The commune covers 5 km² and is bordered by the commune of Yarang Balante. The terrain is generally flat with some minor hilliness. The Sudano-Guinean climate alternates between a dry season (November-May, peaks ~40°C) and a rainy season (June-October, average ~25°C) [14].



Samine is officially composed of six neighborhoods: Samine Santo, Cité Balante, Bafoulabeing, Doumassou, Medina Bouly, and Santassou. In 2022, the ANSD estimated the population at 6,557, with a rare male predominance. The ethnic composition includes Balantes (80%), Fulani (10%), Mandingo (5%), Mandjack (3%), and Wolof and other minorities (5%) [15].

Initially, the commune was served by a single health post, before the opening of a military camp infirmary and later a health center, created in 2016 and operational since 2019 [16]. This center serves the six neighborhoods and over 50 villages in surrounding communes, including some in Guinea-Bissau. It includes a 12-bed inpatient unit, outpatient rooms, maternity ward, vaccination and nutrition services, a dental office, laboratory, pharmacy, and is staffed by doctors, nurses, midwives, community health workers, and support staff [17].

Study type and period

This was a retrospective, descriptive study of patients hospitalized at the Samine Health Center for severe malaria during the period from January 1, 2020, to December 31, 2023.

Study population

Inclusion criteria: We included all male, female, and child patients hospitalized for severe malaria during our study period. The diagnosis of severe malaria was made according to the 2015 WHO definition criteria, namely the presence of asexual forms of *Plasmodium falciparum* in a thick and/or blood smear, associated with at least one of the clinical or laboratory criteria of severity.

Non-inclusion criteria: The following were not included: children under 4 years of age pregnant women and lost or incomplete records.

Data collection

Data were collected from the medical records of hospitalized patients whenever available. A structured questionnaire was used to gather information, including: sociodemographic data (age, sex, marital status, occupation, etc.); treatment history prior to admission; medical history (hypertension, diabetes, asthma, use of herbal medicine, and vaccination history for COVID-19, yellow fever, BCG, meningitis, etc.); hospitalization history; clinical data (signs of severe malaria, depth of coma, and associated clinical signs); paraclinical data (laboratory indicators of severity and

other relevant biological parameters); therapeutic data (type and duration of antimalarial treatment, adjuvant therapies); and outcomes (length of hospitalization, clinical progression including recovery, death, loss to follow-up, or transfer).

Data entry and analysis

Data entry was performed using Microsoft Excel software, analysis with Epi Info 7 version 7.2.6.0, and graphs were created using Microsoft Excel.

Study limitations

Difficulties encountered during data collection The main drawbacks of the study were the incompleteness of the data in the files; and the paucity of paraclinical investigations essential for the diagnosis of severe malaria.

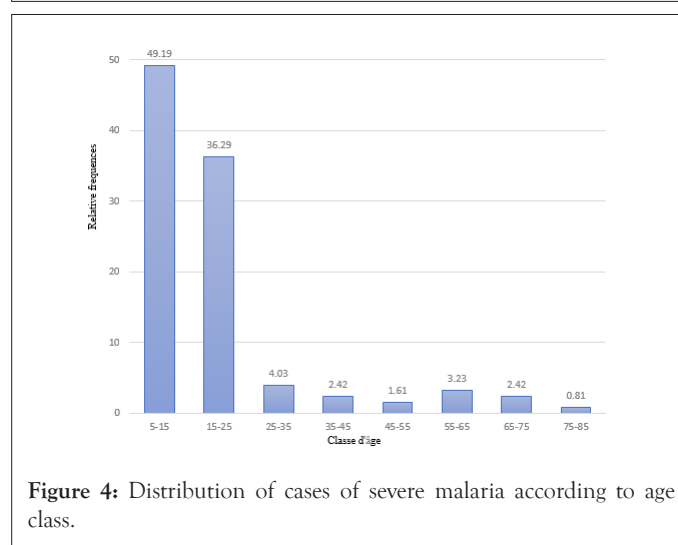
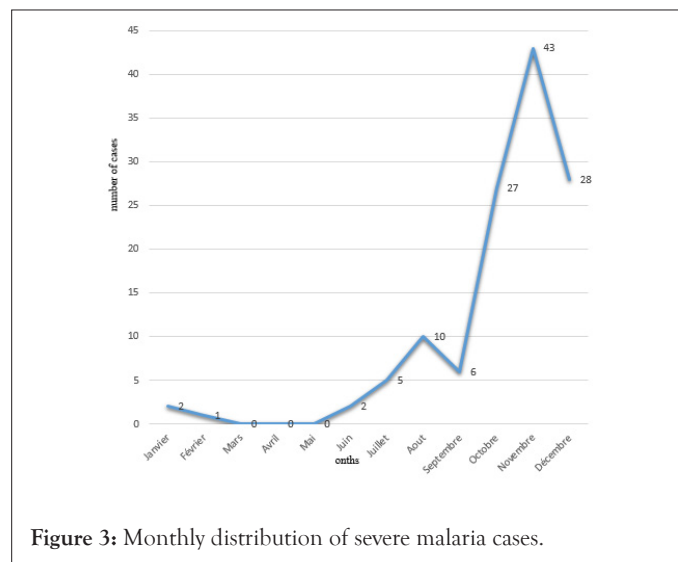
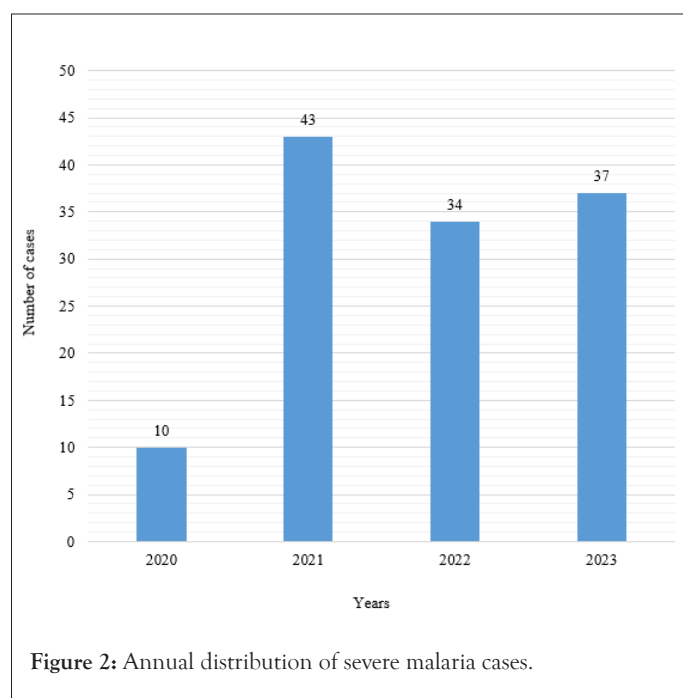
Ethical considerations

The study was conducted with the authorization of the head physician of the Samine health center and the head physician of the Sédhiou region. The data and medical records were handled with strict adherence to medical confidentiality. Furthermore, ethical principles were scrupulously respected throughout.

RESULTS

Epidemiological aspects

During the period, 411 patients were hospitalized in the department, including 124 cases of severe malaria, representing a hospital prevalence of 30.17%. 2021 recorded the majority (34.67%, n=43) of cases (Figure 2). Furthermore, admissions were most frequent in November (34.68%), followed by December (22.58%) and October (21.78%) (Figure 3). The majority of patients were male (66%), with a sex ratio of 1.95. The average age of patients was 18.31 ± 14.68 years, with a predominance of the 5-15 age group (49.19%), followed by the 15-25 age group (36.29%) (Figure 4). Approximately 22.58% (n=28) of patients were referred from nearby health centers, and 33 patients had already received prior treatment, mainly analgesics (51.52%).



Clinical aspects

The main reasons for consultation were fever, observed in 84.68% of patients, followed by vomiting (58.06%) and headache (56.45%) (Table 1).

Table 1: Distribution of cases according to reasons for hospitalization.

Reasons for consultation	Effectif	Pourcentage %
Diffuse pain	21	16,94
Headache	70	56,45
Convulsions	7	5,65
Abdominal pain	12	9,68
Fever	105	84,68
Disturbed consciousness	11	8,87
Vomiting	72	58,06
Arthralgia	1	0,81
Diarrhea	9	7,26

Chills	7	5,65
Myalgia	2	1,61
Dizziness	2	1,61
Agitation	1	0,81
Asthenia	1	0,81

The main clinical signs of severity were prostration (79.84%), jaundice (23.39%), coma (17.74%), and Convulsions and circulatory collapse (4.03%) each (Figure 5).

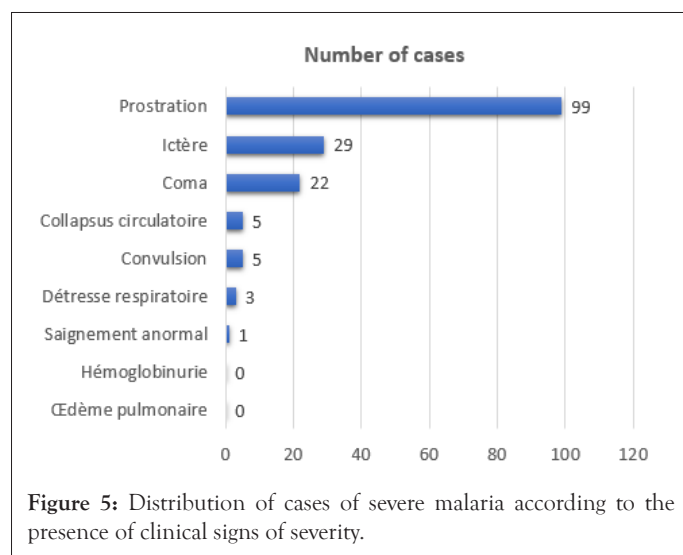


Figure 5: Distribution of cases of severe malaria according to the presence of clinical signs of severity.

Paraclinical aspects

Thick blood smears were positive in 100% of cases, with the presence of *Plasmodium falciparum* and a mean parasite density of 32,372.28 parasites/ μ L $\pm$ 27,772 parasites/ μ L. Anemia was severe in 13.1% of adults (Hb<7 g/dL) and 12.5% of children (Hb<5 g/dL). Thrombocytopenia was present in 80.77%, n=84 cases, of which 36.54%, n=38 was severe (< 50,000 elements/ mm^3). Severe hypoglycemia (FBG<0.4 g/L) was found in one patient and impaired renal function in four patients. Transaminases, measured in 62 patients, were elevated in 45.16 %, n=28. Leukocytosis was noted in 27% of patients (Table 2).

Table 2: Distribution of severe malaria cases according to other biological parameters.

Variables	Mean	Median	Extremes
Platelets (cells/ μ L)	100007,69 $\pm$ 94648,49	65500 (40500; 120000)	11000-591000
Leukocytes (cells/ μ L)	9226 $\pm$ 5162,78	8000(5800; 10200)	2400- 35000
BUN (g/L)	0,4 $\pm$ 0,31	0,32 (0,2300; 0,4800)	0,12-2,56
CRP (mg/L)	170,15 $\pm$ 135,81	96(96; 382)	24-384
AST (IU/L)	105,27 $\pm$ 104,03	76,5(38; 120)	17-579
ALT (IU/L)	52,14 $\pm$ 43	34 (25; 57)	9-200

Therapeutic and outcome aspects

All patients were treated with injectable artesunate, followed by an oral ACT switch. Almost all (93.54%, n=116) of patients had received at least three doses of artesunate. Probabilistic antibiotic therapy was administered to 29 patients (23.39%), including 15 cases (51.72%) on C3G. The average hospital stay was 2.45 days. Progression was favorable in 113 patients (91.13%), while 2.42% discontinued care and 5.65% were transferred to higher-level facilities. Chronic renal failure was noted as the only complication. No deaths were recorded.

DISCUSSION

Epidemiological aspects

The hospital prevalence of severe malaria in Samine was high (30.17%), exceeding that of Touba (14.21%) [12] and Dakar (2.4%-6.6%) [13-15]. This difference may stem from the use of artesunate versus quinine, climate variations, and socioeconomic disparities [16]. The Sudano-Guinean climate, marked by high humidity and rainfall, favors mosquito proliferation and malaria transmission. Seasonal trends showed a rise in cases from August to December, peaking in November, similar to findings in Diourbel and Dakar [12,13,17,18], highlighting the need for intensified prevention during this period. A marked male predominance (sex ratio 1.95) was noted, in line with prior studies [19], and may be linked to occupational exposure, delayed healthcare access, or hormonal factors influencing susceptibility [20-22].

Sociodemographic aspects

The 5-15 age group was most affected (49.19%), followed by 15-25 years, echoing patterns found in Dakar [9]. While malaria has traditionally targeted children under five and pregnant women, waning immunity in adolescents and adults has shifted the disease burden [16]. This decline in immunity is fueled by poorly managed urbanization, drug resistance, malnutrition, and population migration [23-25]. Rural residency, inadequate access to care, and poverty further complicate prevention and treatment [26].

Nearly a quarter of patients had received prior treatment, but only 24.24% had taken ACTs; 51.52% had taken only analgesics. These findings align with other studies from Dakar and Abidjan [9,27,28]. Incomplete or inappropriate treatment poses a risk for severe progression, particularly among non-immune individuals [29]. Herbal medicine use was reported in only two cases but is likely underreported in endemic regions.

Clinical aspects

Fever (mean 38.22°C) and tachycardia (71.72%) were common, consistent with the inflammatory response seen in severe malaria [16,30-33]. Prostration was the most frequent severe sign (79.84%), followed by jaundice (23.39%) [12,17], the latter linked to hemolysis, hepatic dysfunction, or hepatotoxic traditional remedies [9,34].

Neurological symptoms were less frequent: coma occurred in 17.74% and seizures in 4.03%. These rates are lower than those found in Abidjan and Dakar [27,32,33], where deep comas were more common. Conscious comas dominated in this study, similar to findings in Burkina Faso [31]. Regional differences in immunity, parasite burden, and access to care may explain these variations.

Other signs, including circulatory collapse (4.03%), respiratory distress (2.42%), and bleeding (0.81%), reflect the multi-organ failure typical of severe malaria. Classic signs like hemoglobinuria and pulmonary edema were absent, possibly due to underdiagnosis.

Paraclinical findings

All infections were due to *Plasmodium falciparum*, with trophozoite forms only. No hyperparasitemia was observed. The mean parasitemia was 32,372/ μ L, higher than reported in Dakar (2,160-3,428/ μ L) [9,13], possibly reflecting falling premunition in endemic zones [16]. In non-immune patients, parasitemia >2% is associated with severe outcomes [8,35-37].

Severe anemia was observed in 13.1% of adults and 12.5% of children, similar to rates in endemic regions (11-21.6%) [27,9,17,18]. Causes include hemolysis, iron deficiency, poor marrow response, and inflammation [13,38,39].

Severe hypoglycemia was rare (1 case), but dangerous due to clinical overlap with cerebral malaria [40]. Acute kidney injury (3.45%) was less frequent than in other studies (11-27.8%) [27,35], though still a serious prognostic factor [17,41].

Thrombocytopenia was common (80.77%), with severe cases (<50,000/ mm^3) accounting for 36.54%, confirming findings by Wembulua and Yeboua [9,45]. Though rarely causing bleeding, it serves as a sensitive marker of malaria [42-47]. Hyperleukocytosis was seen in 27%, comparable to other series [13,31], and may reflect either immune activation or bacterial co-infection. CRP was elevated in all patients (mean: 170.15 mg/L), confirming its utility as a marker correlating with parasitemia [9,35,43,48,49]. Elevated transaminases (45.16%) indicated hepatic cytolysis due to parasite sequestration, anemia-related hypoxia, and inflammation [16,50,51].

Therapeutic and outcome aspects

Empirical antibiotics were administered to 23.39% of patients, primarily third-generation cephalosporins, based on nonspecific signs like persistent fever and hyperleukocytosis. This practice raises concerns about antimicrobial resistance [19,35,52]. No transfusions were performed due to limited resources.

All patients received injectable artesunate per WHO guidelines, followed by ACTs. Artesunate has proven superior to quinine in trials like AQUAMAT and SEAQUAMAT [53,54].

The average hospital stay was 2.45 days, shorter than in Dakar (6 days) but comparable to Touba (3 days) [12,13]. The outcome was favorable in 91.13% of patients. One case developed chronic renal failure; no deaths were recorded. This may reflect early referral of critical cases, as well as the proven efficacy of artesunate [8,53,54,96]. Ngom et al. similarly reported low mortality (2.22%) in Touba [12].

CONCLUSION

Severe malaria remains a major public health concern in high-transmission regions such as Samine in Sédhiou, Senegal. Our study revealed a high hospital prevalence, particularly among children and young adults, with a seasonal peak during the rainy season. Clinical manifestations were dominated by prostration and jaundice, while biological abnormalities such as thrombocytopenia and hyperleukocytosis were frequent. Despite limited resources, the management based on injectable

artesunate proved effective, with no recorded deaths and a short average hospital stay. However, the recurrence of severe cases and the high burden in young populations highlight the need for strengthened preventive strategies, improved early case detection, and enhanced diagnostic and therapeutic capacities in peripheral health facilities. A better understanding of regional epidemiological patterns is essential to support Senegal's efforts towards malaria elimination by 2030.

AUTHORSHIP CONTRIBUTIONS

Ndèye Fatou NGOM, Fulgence Abdou FAYE, and Bineta Mané Mbengue designed the study. Bineta Mané Mbengue, collected and analyzed data, and wrote the first draft of the manuscript. E. C. A. Diop correct the manuscript translation. All authors reviewed and commented on the manuscript and approved the final its version..

DECLARATION OF COMPETING INTEREST

We declare no competing interests.

ACKNOWLEDGMENTS

We thank all study participants and staff of Health District Sédhiou and all the co-authors of this manuscript.

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