International Journal of Mosquito Research

ISSN: **2348-5906**
CODEN: **IJMRK2**
IJMR 2022; 9(6): 156-162

www.dipterajournal.com
Received: 28-08-2022
Accepted: 30-09-2022

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Four years trends of malaria admissions in rural and urban Kandi health facilities in northeast of Benin Republic

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DOI: https://doi.org/10.22271/23487941.2022.v9.i6b.653

Abstract
Malaria clinical data from health facility records are used for evaluating control programmes' impact and providing insights of epidemiological situation. In the present study we assessed trend of malaria admissions between 2009 and 2012 in rural and urban health facilities of the district of Kandi, a very arid area with particularly severe drought lasting up to 6 months.
Curative care records in the Gansosso urban health facility and Sonsoro rural health facility were consulted and all uncomplicated and severe cases of malaria in local population between 2009 and 2012 were reported. For each malaria case, information on age, gender, origin of the patient were collected on electronic forms using tablets installed with Open Data Kit (ODK) Collect. Characteristics of patients positive to malaria, change in age groups and monthly variation were compared between the urban and rural health facilities.
Of the 21,008 febrile patients consulted, a total of 7,990 cases (38%; 95% CI 37-39) were detected positive to malaria by the means of RDTs or microscopy. The number of confirmed malaria cases in rural and urban Kandi were respectively 2,911 (36%, 95% CI 35-37) and 5,079 (39%, 95% CI 38-40) ($p<0.001$). Severe cases were recorded at a lower frequency in the rural health facility, as compared to the urban one (1% *vs* 25%, $p<0.001$) with most of cases diagnosed in patients from neighbouring villages. Both facilities records showed higher prevalence in females as compared to males (51% *vs* 49%; p =0.97). At rural Kandi, the age group hardest hit was under 5 years representing 40% (95% CI: 38-42) while in urban Kandi, malaria prevalence was higher in the age group older than 15 years (53%; 95% CI: 52-54). Between 2009 and 2012, monthly malaria prevalence was generally higher in rural areas than in urban ones. Except for 2012, peaks of malaria cases occurred earlier in the rural area than in the urban area.
Our study indicated that malaria occurs throughout the year, regardless of the seasons, and affected all age groups in both rural and urban localities. This is of a programmatic interest in designing and planning vector control interventions particularly in endemic settings.

Keywords: Malaria, prevalence, *Plasmodium falciparum*, microscopy, RDT, kandi

Introduction
Recently there was a renewed interest in research and the fight against malaria in endemic settings. Progress of the past years is the result of adaptation to changes in the epidemiology of malaria, *Anopheles* vectors and *Plasmodium* parasites [1-3]. In fact, success in the control of malaria requires among other things adequate monitoring of data on populations at risk and malaria cases [4]. This information is an important programmatic parameter needed in designing and implementing novel vector control interventions for significant epidemiological impact [5].
In most of malaria endemic countries, health facility based data are generally accessible since they are often used for evaluating control programmes' impact and providing insights of epidemiological situation [6]. Malaria clinical data from health facility records are used to assess impact of control interventions such as long-lasting insecticidal nets (LLINs) distribution. Although the use of these facility-based data is cost-effective, they are subject to several pitfalls that require to be avoided, minimized, or acknowledged [7]. The weaknesses are associated with completeness, validity and representativeness due to methods of collection, analysis and reporting in many settings [7-9].

When facility reports on malaria cases are accurate, they allow to assess any clustering of malaria cases as well as pockets of transmission to guide targeted interventions [7, 10].

In North Benin, the district of Kandi is a very arid area with particularly severe drought lasting 6 months during which significant cases of malaria are detected in health facilities [11]. Even if these unexpected cases could be linked to relapses or imported cases of malaria, the possibility of recent infections cannot be ruled out given the magnitude of the prevalence. In the current study, we used health facility data from urban and rural areas to assess trend of malaria admissions between 2009 and 2012. In view of the harmful effects of climate change marked by increasingly high temperatures and longer droughts, it is important to monitor the burden of malaria in every epidemiological context for appropriate responses.

Methods

Study area

This study was carried out in Kandi, northeast of Benin. Kandi is under a Sudanian climate with a dry season from November to April and a Wet season from May to October. During the dry season, temperatures are very high and up to 45°C can be recorded. Every year, the drought is always very severe, lasting up to 6 months with a lot of sunshine.

Study design

Retrospective data of malaria burden were collected in two health facilities of which the district health centre of Gansosso located in urban area and sub-district health facility of sonsoro situated in rural Kandi. The curative care records were consulted and all uncomplicated and severe cases of malaria in local population between 2009 and 2012 were reported. For each malaria case, information on age, gender, origin of the patient were collected.

Health care facilities

The district health centre of Gansosso and sub-district health facility of Sonsoro are public service hospitals. According to the health pyramid in the Republic of Benin, the district health centre of Gansosso belongs to the intermediate level. It is located in the urban area of Kandi which counted a population of 20,537 inhabitants in 2,997 households according to 2013 statistics [12]. The sub-district health centre of Sonsoro district health center is a peripheral facility located in a rural area and covers 22,920inhabitants living in a total of 3,022 [12].

Data management

Data on malaria cases were collected from the health facilities records on electronic forms using tablets installed with OpenDataKit (ODK) Collect. Characteristics of patients positive to malaria, change in age groups and monthly variation were compared between the urban district facility of Gansosso and the rural sub-district of Sonsoro. All statistical analyses were performed using Stata version 15.0 (Stata Corp., College Station, TX).

Results

Trends in malaria prevalence among febrile patients over time

Table 1 shows statistics of positive malaria cases across gender, age groups and origins over the period between January 2009 and December 2012 in the 2 study health facilities in Kandi. Of the 21,008 febrile patients consulted, a total of 7,990 cases (38%; 95% CI 37-39) were detected positive to malaria by the means of RDTs or microscopy. The number of confirmed malaria cases in rural and urban Kandi were respectively 2,911 (36%, 95% CI 35-37) and 5,079 (39%, 95% CI 38-40) (p<0.001). Severe cases were recorded at a lower frequency in the rural health facility, as compared to the urban one (1% *vs* 25%, p<0.001). However 81% of confirmed malaria cases in the urban centre were diagnosed in patients from neighbouring villages, whereas all the positive cases in the rural hospital were autochthonous.

The distribution of confirmed malaria cases across gender for the period 2009–2012 in both rural and urban health facilities showed higher prevalence in females as compared to males (51% *vs* 49%; p =0.97) (Table 1). However, the number of malaria confirmed cases varied between different age groups from one health facility to the other. From the malaria cases recorded at rural Kandi, the age group hardest hit was under 5 years representing 40% (95% CI: 38-42) while patients of 5 to 14 years and > 15 years constituted respectively 29% (95% CI: 27-31) and 30% (95% CI: 28-32). Data recorded form urban Kandi showed that malaria prevalence was higher in the age group older than 15 years (53%; 95% CI: 52-54) than in 5 to 14 years (28%; 95% CI: 27-29) and under 5 years (19%; 95% CI: 18-20) (Table 1).

Change of malaria prevalence in age groups over years in rural and urban health facilities

Figure 1 summarises the proportion of positive confirmed malaria cases between age groups at different settings over the study period. From 2008 and 2012, the malaria prevalence in patients of 5 to 15 years looked similar between the rural health facility (24% -34) and the urban facility (21%-34%; p > 0.05) of the district of Kandi. The trend in children under 5 years showed a significantly higher prevalence in the rural health facility than in the urban one in 2009 (54% *vs* 35%, p<0.001), 2010 (33% *vs* 4%; p<0.001), 2011 (33% *vs* 12%; p<0.001) unlike in 2012 (36% *vs* 32%; p = 0.15). In the group of adults above 15 years, malaria prevalence was similar in both facilities in 2012 (30% *vs* 34%, p = 0.101) while individuals consulted at the urban health facility provided higher prevalence as compared to the rural hospital between 2009 and 2011 (44%-69% *vs* 22%-36%, p<0.001).

Monthly variation in the malaria prevalence between rural and urban health facilities

Figures 2-5 show monthly variation of malaria prevalence across rural and urban health facilities between 2009 and 2012. Monthly prevalence was generally higher in rural areas than in urban ones. Except for 2012, peaks of malaria cases occurred earlier in the rural area than in the urban area.

In 2009, the monthly proportion of positive malaria cases in patients consulted ranged from 29% to 65% in the rural health centre against 26% to 53% in the hospital of urban Kandi (Figure 2). Peak of malaria positive cases was observed between July and August in both health centres and again in November only in the rural area (Figure 2). In 2010, the proportion of positive cases varied from 16% to 97% and 33% to 68% respectively in the rural an urban health facilities with peak of case detection in July for the rural centre and November in the urban centre area (Figure 3). While in 2011, the positive cases ranged between 20% and 92% for the rural Kandi health facility, and 26% to 54% for the urban facility, the peak of cases was respectively observed in May and

October (Figure 4). Finally in 2012, positivity in malaria cases varied between 11% and 59% in rural Kandi health centre against 16% to 60% in the urban facility area (Figure 5). Unlike 2009 to 2011, the peak of malaria cases was observed first in the urban area June and after 2 months (August) in the rural one (Figure 5).

Discussion

The eventual changes of epidemiology of malaria across endemic areas require appropriate control measures. In this study, we assessed the trend of malaria admissions between 2009 and 2012 in the extreme drought conditions of urban and rural areas of the district of Kandi, northeastern Benin, where new cases are continuously reported. The positive malaria cases reported in the current study were *P. falciparum* infections confirmed by the means of either microscopy or rapid diagnostic test (RDT) as recommended by the World Health Organization guidelines [13]. As there was a laboratory in the urban health facility of Kandi, microscopy using thin and thick blood slides were the main malaria diagnosis method. Conversely, only RDT was used in the rural health facility due to a very limited personnel, infrastructure and equipment. As the gold standard in malaria diagnosis, microscopy is of a superior sensitivity compared to RDT which exhibits high specificity and low sensitivity and constitutes an useful tool to prevent danger associated with late diagnosis [14, 15]. It would have been interesting to have the same method used in both areas. However since the two methods are WHO-recommended, it does not pose a major problem as the malaria cases considered in this study were confirmed by one or the other.

Over the study period, a total of 7,990 confirmed malaria cases representing 38% of febrile cases were reported in the study area. While severe malaria cases was recorded at a lower frequency in the rural health facility as compared to the urban health facility, data of distribution of patients according to their place of residence showed that 51% of positive cases actually came from rural locations. This finding was similar to what had been observed in many settings including Gabon [16], Burkina Faso [17], Nigeria [18] with high proportion of severe anaemia and case fatality rate in rural areas. There are many factors driving the higher malaria transmission in rural areas across endemic countries. On the human side, during rainy seasons, occupations take people away from the protection of vector control tools (LLINs and IRS), at peak biting times, notably in communities practicing subsistence farming which use to stay overnight in farms with precarious houses often completely or partly opened [19-21]. This situation is aggravated by the lack of sufficient LLINs and low use as reported by Edward *et al.* [22]. Previous studies in Kandi reported continuous malaria transmission throughout the year including in dry seasons [23], with domestic drought-refugia of anopheline larvae [24]. Unfortunately, as mosquito bites are less noticeable at this time of the year, in nights sometimes excessively hot, people do not feel the need to sleep under bed nets and trivialize any other method of protection against possible scarce mosquito bites.

The number of malaria confirmed cases varied between different age groups from one health facility to the other. From the malaria cases recorded at rural Kandi, the age group hardest hit was under 5 years representing 40% (95% CI: 38-40) while patients of 5 to 14 years and > 15 years constituted respectively 29% (95% CI: 27-29) and 30% positive malaria cases (95% CI: 28-32). Data recorded form urban Kandi showed that malaria prevalence was higher in the age group older than 15 years (53%; 95% CI: 52-54) than in 5 to 14 years (28%; 95% CI: 27-29) and under 5 years (19%; 95% CI: 18-20). It has been admitted that the most vulnerable persons to malaria are the ones with no or little immunity against the disease such as children under 5 years [25] as observed in the rural health facility. The higher malaria prevalence recorded in adult patients in urban health facility as compared to rural facility might also be explained by the fact that most of them originated from rural areas.

Table 1: Statistics of positive malaria cases across rural and urban health facilities between 2009 and 2012

		Rural area			Urban area			Total		
		N	**%**	**95%-CI**	**N**	**%**	**95%-CI**	**N**	**%**	**95%-CI**
Total of patients consulted		8,033	-	-	12,975	-	-	21,008	-	-
Total of malaria cases		2,911	36	35-37	5,079	39	38-40	7,990	38	37-39
Gender	Female	1,488	51	49-53	2,594	51	50-52	4,082	51	50-52
	Male	1,423	49	47-51	2,485	49	48-50	3,908	49	48-50
Origin	Urban	2,911	100	-	980	19	18-20	3,891	49	48-50
	Rural	0	0	-	4,099	81	80-82	4,099	51	50-52
Age	< 5 years	1,173	40	38-42	990	19	18-20	2,163	27	25-27
	5-14 years	856	29	27-31	1,405	28	27-29	2,261	28	27-29
	> 15 years	882	30	28-32	2,684	53	52-54	3,566	45	44-46
Type	Uncomplicated	2,875	99	98-100	3,806	75	74-76	6,681	84	83-85
	Severe	36	1	0-2	1,273	25	24-26	1,309	16	15-17

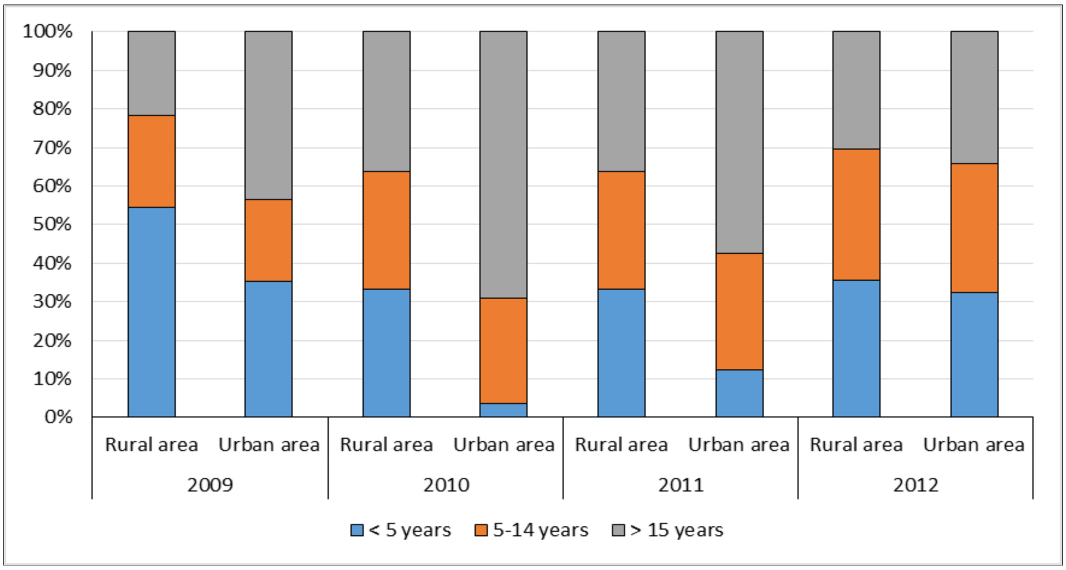

Fig 1: Change of malaria prevalence in age groups over years in rural and urban health facilities

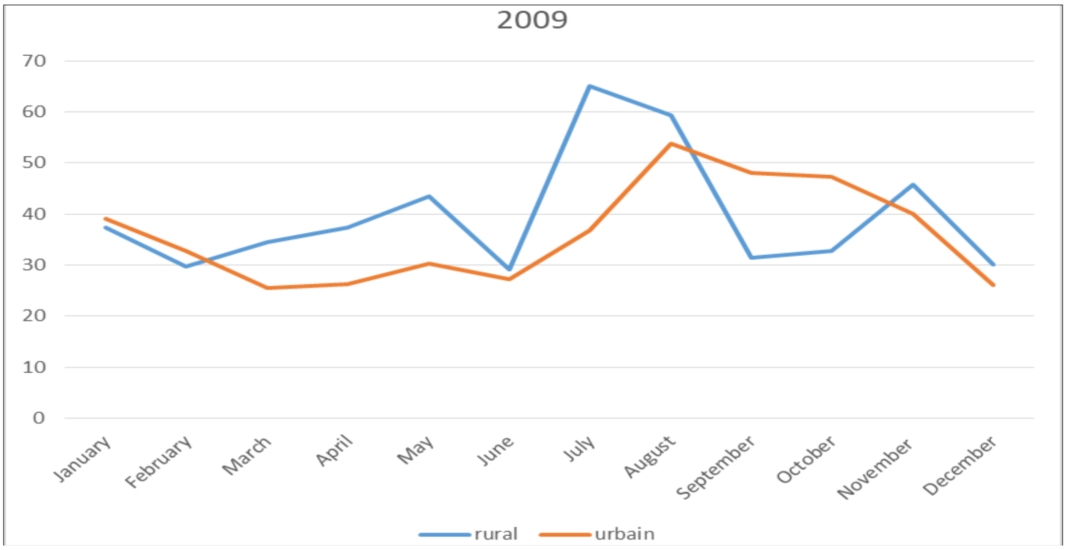

Fig 2: Monthly variation of malaria prevalence across rural and urban health facilities in 2009 for all group age combined

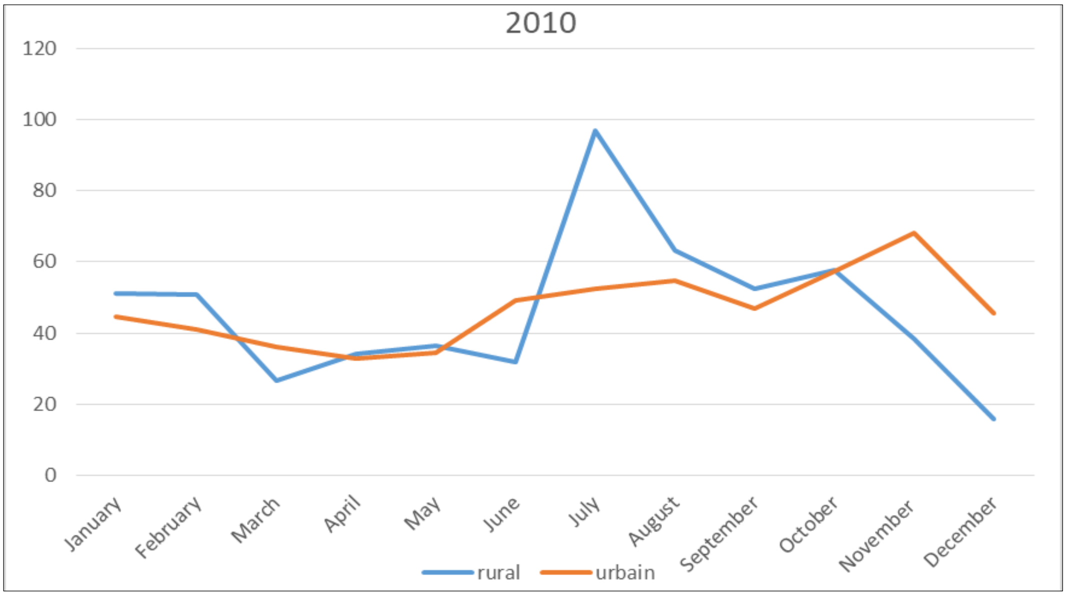

Fig 3: Monthly variation of malaria prevalence across rural and urban health facilities in 2010 for all group age combined

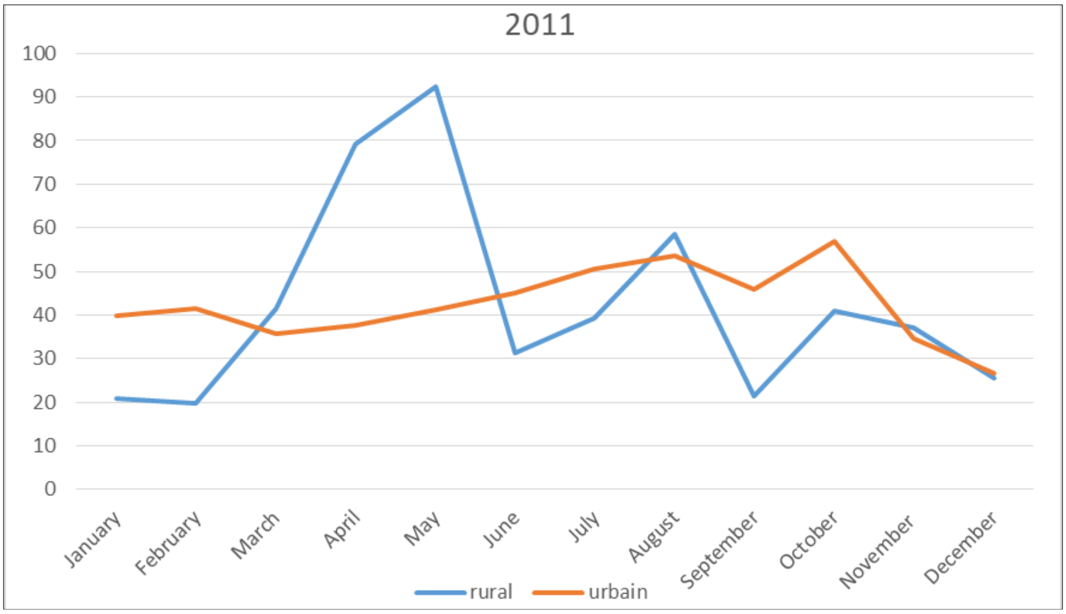

Fig 4: Monthly variation of malaria prevalence across rural and urban health facilities in 2011 for all group age combined

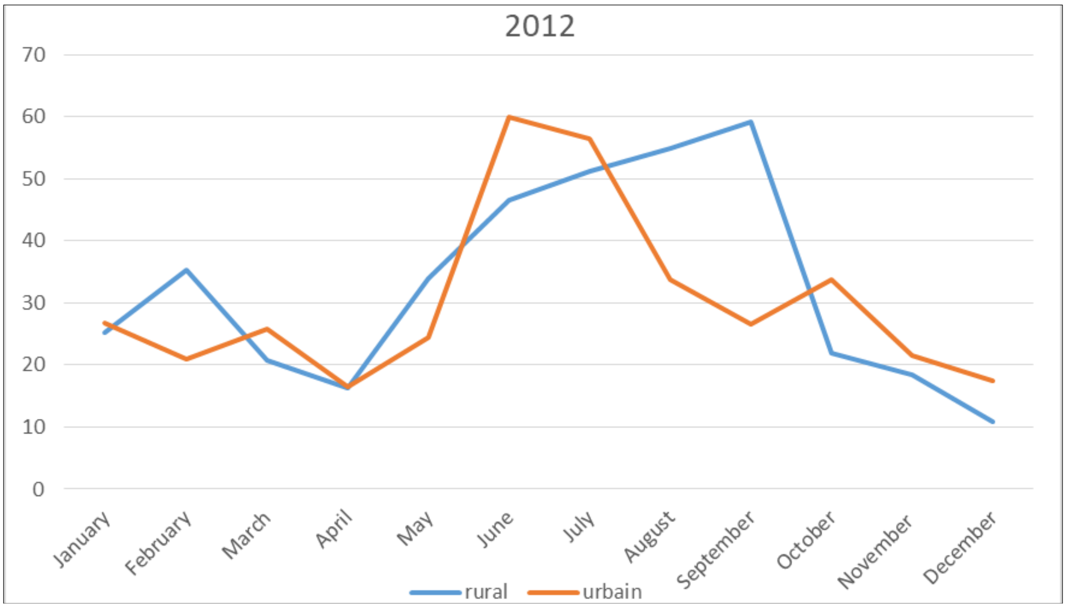

Fig 5: Monthly variation of malaria prevalence across rural and urban health facilities in 2012 for all group age combined

Conclusion

The data from our investigations conducted between 2008 and 2012 indicate that malaria occurs throughout the year, regardless of the seasons, and affects all age groups in both rural and urban localities. This is of a programmatic interest in designing and planning vector control interventions particularly in endemic settings.

Competing interests

The authors declare that they have no competing interests.

Funding

The study was part of a PhD project and was funded by Centre for Research in Entomology of Cotonou, in Benin.

Authors' contributions

RG and MA wrote the main study protocol and design the study. RO, AS and RG supervised the study data collections. RG performed data analysis. RG wrote the initial draft of the manuscript, which was revised by AS. MA provided administrative and logistics support. All authors read and approved the final manuscript.

Acknowledgements

We thank health authorities of Kandi for their collaboration.

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