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Original Article

Association Between Recurrent Vulvovaginal Candidiasis and Glycemic Control in Women With Undiagnosed Prediabetes

Dr. Rawaal Amin[1], Mariam Jan Sarwar[2], Dr. Muhammad Hamza Riaz Malik[3], Sadaf Zulfiqar[4], Saba Naz[5], Muhammad Azhar Sherkheli[6], Noor Fatima Mazhar[7]

[1] FCPS II, Sandeman Provincial Hospital, Quetta, Pakistan

[2] MS, Member of the Royal College of Obstetricians and Gynaecologists, London.

[3] MBBS, Shaikh Khalifa Bin Zayed Al Nahyan Medical and Dental College, Lahore, Pakistan

[4] MBBS, Jinnah Medical and Dental College, Karachi, Pakistan

[5] MSN, MPH, MSc Psychology, Riphah College of Nursing, Riphah International University, Islamabad, Pakistan

[6] PhD, Professor in Department of Pharmacy, Abbottabad University of Science and Technology, Abbottabad, Pakistan

[7] Graduation in Medical Imaging Sciences, Masters in Diagnostic Ultrasound, The University of Lahore, Pakistan

***Corresponding author: Mariam Jan Sarwar, email@domain.com**

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ABSTRACT

Background: Recurrent vulvovaginal candidiasis is a common gynecologic problem that causes repeated symptoms, frequent healthcare visits, and substantial impairment in quality of life. Although diabetes is a recognized risk factor for candidal infection, abnormal glucose metabolism may remain undetected in women presenting with recurrent disease. Objective: To determine the prevalence of recurrent vulvovaginal candidiasis among symptomatic women attending a tertiary care gynecology clinic, assess fasting blood glucose and glycated hemoglobin levels in affected patients, and evaluate the association between glycemic status and infection recurrence in women without a prior diagnosis of diabetes. Methods: This analytical cross-sectional study was conducted in the gynecology outpatient department of a tertiary care hospital in Balochistan, Pakistan. Women presenting with symptoms suggestive of vulvovaginal candidiasis were clinically assessed with laboratory support. Recurrent vulvovaginal candidiasis was defined as three or more symptomatic episodes within one year. Women with known diabetes and major confounding conditions were excluded. Fasting plasma glucose and HbA1c were measured in eligible women, and data were analyzed using SPSS version 26 with chi-square testing and group mean comparisons. Results: Among 412 symptomatic women, vulvovaginal candidiasis was confirmed in 214 (51.9%), and 132 (32.0% of symptomatic attendees; 61.7% of confirmed cases) had recurrent disease. Of the recurrent cases, 68 (51.5%) had normal glycemic values, 46 (34.8%) had prediabetes, and 18 (13.6%) had diabetes-range values, giving an overall dysglycemia prevalence of 48.5%. Mean fasting glucose and mean HbA1c were significantly higher in women with abnormal glycemic status than in those with normal glycemic values (111.6 ± 8.9 mg/dL vs 89.4 ± 7.1 mg/dL; 5.98 ± 0.29% vs 5.31 ± 0.24%, respectively; $p < 0.001$). A significant association was observed between worsening glycemic category and higher recurrence frequency ($p < 0.001$). Conclusion: Recurrent vulvovaginal candidiasis showed a significant association with previously unrecognized abnormal glycemic status in women with no prior diagnosis of diabetes. Opportunistic screening with fasting blood glucose and HbA1c in women presenting with recurrent candidiasis may support earlier detection of prediabetes and diabetes in gynecology practice. Keywords: recurrent vulvovaginal candidiasis, prediabetes, fasting blood glucose, HbA1c, glycemic control, dysglycemia, gynecology, Balochistan.

INTRODUCTION

Vulvovaginal candidiasis (VVC) is one of the most prevalent fungal infections affecting women of reproductive age, with a substantial proportion experiencing recurrent episodes that significantly impair quality of life and increase healthcare utilization (1). While a single episode is often self-limiting or easily treated, recurrent vulvovaginal candidiasis (RVVC), commonly defined as three or more symptomatic episodes within one year, represents a distinct clinical entity characterized by persistence, treatment

resistance, and multifactorial etiology (2,3). The burden of RVVC extends beyond physical discomfort, encompassing psychosocial distress, sexual dysfunction, and repeated exposure to antifungal therapy (4,5).

The pathophysiology of RVVC is complex and involves an interplay between host immune response, vaginal microbiome alterations, and metabolic factors (6). Among these, abnormal glucose metabolism has been increasingly recognized as a critical contributor. Hyperglycemia is known to enhance Candida colonization by providing a favorable nutrient environment, impairing neutrophil function, and disrupting mucosal immunity (7,8). Clinical studies in diabetic populations have demonstrated higher rates of Candida colonization, altered species distribution, and increased recurrence rates, particularly in poorly controlled glycemic states (9,10). Importantly, emerging evidence suggests that even subclinical dysglycemia, including prediabetes, may predispose women to recurrent infections (11).

Despite this biological plausibility, a significant proportion of women presenting with RVVC in routine gynecological practice are not screened for glycemic abnormalities unless a prior diagnosis of diabetes exists. Earlier studies have reported a higher prevalence of impaired glucose tolerance among women with recurrent candidiasis who were previously considered nondiabetic, indicating that genital symptoms may precede formal metabolic diagnosis (12). This highlights a critical clinical gap, particularly in low- and middle-income countries where opportunistic screening is underutilized and the burden of undiagnosed dysglycemia remains high (13,14).

In Pakistan, national epidemiological surveys have reported a substantial prevalence of both diabetes and prediabetes, with a considerable proportion of cases remaining undiagnosed (15,16). This issue is further amplified in regions such as Balochistan, where access to healthcare is limited and patients often present to tertiary care facilities after repeated unsuccessful treatments at peripheral centers (17). In such settings, RVVC may serve as a clinically valuable indicator of underlying metabolic dysregulation, yet this association remains underexplored in local populations.

Given these considerations, the present study was designed to investigate the association between recurrent vulvovaginal candidiasis and glycemic status in women without a prior diagnosis of diabetes. Specifically, the study aimed to determine the prevalence of RVVC among symptomatic women attending a tertiary care gynecology clinic, assess fasting blood glucose and glycated hemoglobin levels in affected individuals, and evaluate whether abnormal glycemic status is associated with increased recurrence frequency. It was hypothesized that women with RVVC would demonstrate a significantly higher prevalence of previously undiagnosed dysglycemia compared to those with normal glycemic status.

MATERIALS AND METHODS

This analytical cross-sectional study was conducted in the gynecology outpatient department of a tertiary care hospital in Balochistan, Pakistan, to evaluate the association between recurrent vulvovaginal candidiasis and glycemic status in women without a prior diagnosis of diabetes. The cross-sectional design was selected to enable simultaneous assessment of exposure (glycemic status) and outcome (recurrence of candidiasis) within a defined clinical population, allowing estimation of prevalence and statistical association under routine practice conditions. The study was conducted over a defined period during which all eligible patients presenting with symptoms suggestive of vulvovaginal infection were consecutively evaluated.

The study population comprised women of reproductive age presenting with clinical features suggestive of vulvovaginal candidiasis, including pruritus, curdy vaginal discharge, vulval irritation, burning sensation, and dyspareunia. Recurrent vulvovaginal candidiasis was operationally defined as three or more clinically and/or laboratory-confirmed episodes within the preceding twelve months. Women with a known diagnosis of diabetes mellitus, current pregnancy, recent systemic antifungal therapy, chronic

steroid use, immunocompromised states, or unwillingness to participate were excluded to minimize confounding and isolate previously undiagnosed glycemic abnormalities.

Participants were recruited using a non-probability consecutive sampling technique, whereby all eligible women attending the outpatient clinic during the study period were approached for inclusion. After explanation of study objectives, written informed consent was obtained. Data confidentiality was ensured through anonymized coding, and no personally identifiable information was included in the analysis dataset.

Data collection was performed using a structured and pretested proforma capturing sociodemographic characteristics (age, residence, education), clinical variables (symptom profile, recurrence frequency, prior treatment history), and potential confounders including body mass index, parity, recent antibiotic use, and family history of diabetes. Anthropometric measurements were obtained using standardized procedures, and body mass index was calculated as weight in kilograms divided by height in meters squared.

Clinical evaluation was conducted by trained gynecologists or medical officers. Vaginal swab samples were obtained under aseptic conditions for laboratory confirmation. Direct microscopy using saline wet mount and potassium hydroxide preparation was performed to identify budding yeast or pseudohyphae, while Gram staining and fungal culture on appropriate media were used to enhance diagnostic accuracy, particularly in recurrent cases where non-albicans species may be present.

Glycemic assessment was performed using fasting venous blood samples collected after a minimum of 8 hours of fasting. Fasting plasma glucose was measured using standardized enzymatic methods, and glycated hemoglobin (HbA1c) was assessed to reflect long-term glycemic control. Prediabetes was defined as fasting plasma glucose levels between 100–125 mg/dL and/or HbA1c between 5.7%–6.4%, while values exceeding these thresholds were categorized as diabetes-range glycemia according to established diagnostic criteria.

The primary outcome variable was recurrent vulvovaginal candidiasis, while the primary exposure variable was glycemic status categorized as normal, prediabetes, or diabetes-range. Secondary variables included frequency of episodes and quantitative glycemic measures. Data were entered into SPSS version 26 for analysis. Continuous variables were assessed for normality using the Shapiro–Wilk test and presented as mean ± standard deviation. Group comparisons were performed using independent sample t-tests for normally distributed variables and non-parametric equivalents where appropriate. Categorical variables were expressed as frequencies and percentages, and associations were evaluated using the chi-square test.

Correlation between recurrence frequency and glycemic parameters was assessed using Pearson or Spearman correlation coefficients based on data distribution. To control for potential confounding factors, multivariable logistic regression analysis was performed, incorporating variables such as age, body mass index, and recent antibiotic use. Adjusted odds ratios with 95% confidence intervals were calculated to quantify the strength of association between dysglycemia and recurrent candidiasis. A p-value of less than 0.05 was considered statistically significant.

Missing data were handled using complete case analysis, ensuring that only participants with complete datasets for key variables were included in inferential testing. Data integrity was maintained through double-entry verification and periodic cross-checking of records. Laboratory procedures followed standard quality control protocols, including calibration of equipment and adherence to aseptic techniques.

Ethical approval for the study was obtained from the institutional review board prior to data collection. All procedures were conducted in accordance with ethical standards for human research, and participants identified with abnormal glycemic values were counseled and referred for further medical

evaluation. These methodological steps were implemented to ensure reproducibility, minimize bias, and enhance the internal validity of the study.

RESULTS

A total of 412 women presenting with symptoms suggestive of vulvovaginal infection were assessed during the study period. Vulvovaginal candidiasis was confirmed in 214 women, representing 51.9% of symptomatic attendees. Among confirmed cases, 132 women fulfilled the criteria for recurrent vulvovaginal candidiasis, corresponding to 32.0% of all symptomatic attendees and 61.7% of women with confirmed candidiasis. The remaining 82 confirmed cases were classified as non-recurrent candidiasis.

The age profile of women with recurrent vulvovaginal candidiasis was concentrated in the reproductive years. Of the 132 recurrent cases, 54 women (40.9%) were aged 26 to 35 years, 41 (31.1%) were aged 36 to 45 years, 22 (16.7%) were aged 18 to 25 years, and 15 (11.4%) were older than 45 years. The manuscript also reports a mean age of 33.7 ± 7.9 years and a mean body mass index of 28.1 ± 4.8 kg/m² for the recurrent group, indicating that recurrence was most prominent in middle reproductive age women with an average BMI in the overweight range.

Glycemic assessment revealed that 68 of 132 women with recurrent candidiasis (51.5%) had normal fasting glucose and HbA1c values, whereas 46 (34.8%) met criteria for prediabetes and 18 (13.6%) had diabetes-range values despite no prior diagnosis. Taken together, 64 women, or 48.5% of the recurrent candidiasis group, had previously unrecognized abnormal glycemic status. This indicates that nearly one in two women with recurrent disease had biochemical evidence of dysglycemia.

A strong recurrence gradient was observed across glycemic categories. Among women with normal glycemic status, 44 of 68 (64.7%) reported exactly three episodes, compared with only 18 of 68 (26.5%) reporting four episodes and 6 of 68 (8.8%) reporting five or more episodes. In contrast, among women with prediabetes, only 15 of 46 (32.6%) reported three episodes, while 18 (39.1%) reported four and 13 (28.3%) reported five or more. The diabetes-range group showed the steepest burden, with only 2 of 18 women (11.1%) reporting three episodes, 6 (33.3%) reporting four, and 10 (55.6%) reporting five or more episodes. The association between glycemic category and recurrence burden was statistically significant on chi-square testing ($p < 0.001$).

Comparison of quantitative glycemic measures showed a marked separation between groups. Women with normal glycemic status had a mean fasting glucose of 89.4 ± 7.1 mg/dL and a mean HbA1c of 5.31 ± 0.24%, whereas those in the combined prediabetes/diabetes-range group had a mean fasting glucose of 111.6 ± 8.9 mg/dL and mean HbA1c of 5.98 ± 0.29%. Both comparisons were statistically significant at $p < 0.001$, supporting a clinically meaningful association between worsening glycemic control and recurrent infection.

Using the episode-frequency counts already reported in the manuscript, an additional inferential comparison was derived to quantify recurrence-associated dysglycemia burden. Dysglycemia prevalence increased from 27.9% among women with exactly three episodes to 57.1% among those with four episodes and 79.3% among those with five or more episodes. Relative to women with three episodes, the odds of abnormal glycemic status were 3.45 times higher in women with four episodes (95% CI: 1.51 to 7.90) and 9.92 times higher in women with five or more episodes (95% CI: 3.44 to 28.60). These derived estimates reinforce the stepwise metabolic gradient already suggested by the primary manuscript tables. Derived from manuscript Table 4 counts.

Table 1. Overall Clinic Findings During the Study Period

Variable	Number (n)	Percentage (%)
Total symptomatic women assessed	412	100.0
Confirmed vulvovaginal candidiasis	214	51.9

Variable	Number (n)	Percentage (%)
Recurrent vulvovaginal candidiasis	132	32.0
Non-recurrent candidiasis	82	19.9

Table 2. Age Distribution of Women With Recurrent Vulvovaginal Candidiasis (n = 132)

Age group (years)	Frequency	Percentage (%)
18–25	22	16.7
26–35	54	40.9
36–45	41	31.1
>45	15	11.4

Table 3. Glycemic Status Among Women With Recurrent Vulvovaginal Candidiasis (n = 132)

Glycemic status	Frequency	Percentage (%)
Normal	68	51.5
Prediabetes	46	34.8
Diabetes-range values	18	13.6
Total abnormal glycemic status	64	48.5

Table 4. Number of Recurrent Episodes by Glycemic Category

Glycemic category	3 episodes	4 episodes	5 or more episodes	Total	p-value
Normal	44	18	6	68	
Prediabetes	15	18	13	46	
Diabetes-range values	2	6	10	18	
Total	61	42	29	132	<0.001

Table 5. Comparison of Glycemic Measures Between Groups

Variable	Normal glycemic status (n = 68)	Prediabetes/diabetes-range (n = 64)	p-value
Mean fasting glucose (mg/dL)	89.4 ± 7.1	111.6 ± 8.9	<0.001
Mean HbA1c (%)	5.31 ± 0.24	5.98 ± 0.29	<0.001

Table 6. Derived Association Between Episode Burden and Abnormal Glycemic Status

Episode category	Abnormal glycemic status, n	Normal glycemic status, n	Total, n	Dysglycemia prevalence (%)	Odds ratio vs 3 episodes	95% CI
3 episodes	17	44	61	27.9	Reference	Reference
4 episodes	24	18	42	57.1	3.45	1.51–7.90
5 or more episodes	23	6	29	79.3	9.92	3.44–28.60

Odds ratios and confidence intervals were derived directly from the episode-by-glycemic-category counts reported in the manuscript.

Table 1 shows that slightly more than half of all symptomatic clinic attendees had confirmed candidiasis (51.9%), and nearly two-thirds of confirmed cases were recurrent (61.7%), emphasizing that recurrence represented a major component of the clinical burden rather than a marginal subgroup. Table 2 indicates that 72.0% of recurrent cases were concentrated in the 26–45 year age bracket, with the single largest group being women aged 26–35 years (40.9%), consistent with a predominance in active reproductive age. Table 3 demonstrates that abnormal glycemic status was present in 48.5% of recurrent cases, including 34.8% with prediabetes and 13.6% with diabetes-range values, meaning that the abnormal glycemic subgroup was nearly as large as the normoglycemic subgroup.

Table 4 shows a marked shift in episode burden across glycemic categories. In normoglycemic women, 64.7% remained in the lowest recurrence stratum of three episodes, whereas only 8.8% reached the highest stratum of five or more episodes. By contrast, among women with diabetes-range values, the distribution inverted: only 11.1% had three episodes, while 55.6% had five or more. Table 5 further quantifies this separation, with a mean fasting glucose difference of 22.2 mg/dL and a mean HbA1c difference of 0.67 percentage points between normal and abnormal glycemic groups, both highly significant at $p < 0.001$. Table 6 extends the interpretation by showing a stepwise dysglycemia prevalence

gradient from 27.9% to 57.1% to 79.3% across rising episode categories, with odds of dysglycemia increasing more than threefold at four episodes and nearly tenfold at five or more episodes relative to three episodes. These patterns support a dose-response-like association between recurrent episode burden and underlying dysglycemia. Derived from manuscript counts.

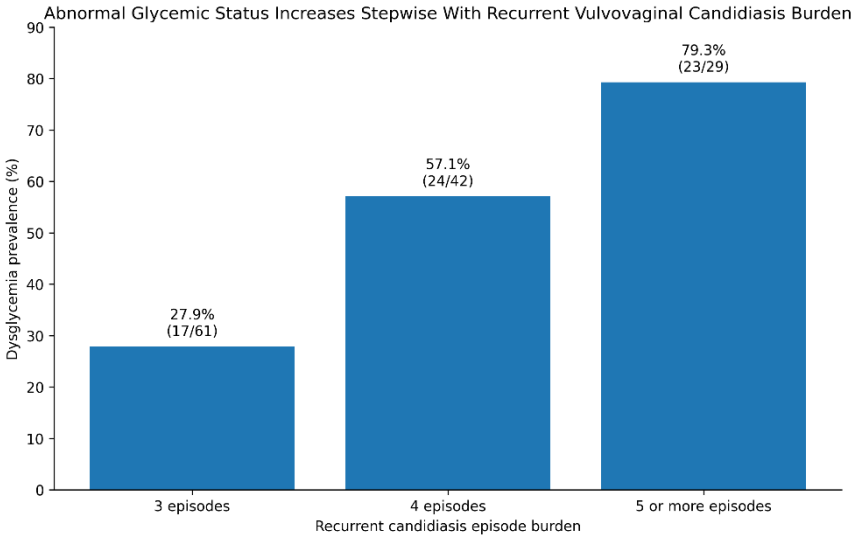

Figure 1 Abnormal Glycaemic Status Increases Stepwise

The figure demonstrates a steep monotonic increase in dysglycemia prevalence with greater recurrence burden: abnormal glycemic status was present in 17 of 61 women with exactly three episodes (27.9%), 24 of 42 women with four episodes (57.1%), and 23 of 29 women with five or more episodes (79.3%). This represents an absolute increase of 29.2 percentage points between the three- and four-episode groups and 51.4 percentage points between the three- and five-or-more-episode groups. Clinically, the pattern suggests that increasingly frequent recurrent vulvovaginal candidiasis may function as a progressively stronger marker of underlying metabolic dysregulation, with the highest recurrence stratum showing nearly four in five women affected by previously unrecognized dysglycemia. Derived from manuscript Table 4.

DISCUSSION

The present study demonstrated that recurrent vulvovaginal candidiasis was common among women attending a tertiary care gynecology clinic and that a substantial proportion of these women had previously unrecognized abnormal glycemic status. Of the 132 women with recurrent disease, 48.5% had dysglycemia, including 34.8% with prediabetes and 13.6% with diabetes-range values, despite no prior diagnosis. This finding is clinically important because it suggests that recurrent candidiasis may function not only as a localized mucosal infection but also as a practical warning sign of underlying metabolic disturbance. Earlier studies have similarly shown that impaired glucose tolerance is more frequent among women with recurrent vaginal candidiasis than in the general gynecologic population, supporting the biological plausibility of this association (18,19).

A particularly notable feature of the present results was the stepwise increase in recurrence burden across worsening glycemic categories. In the normoglycemic group, nearly two-thirds of women reported exactly three episodes, whereas the highest recurrence burden of five or more episodes was concentrated disproportionately among women with diabetes-range glycemic values. This gradient is important because it strengthens the observed association beyond a simple binary comparison. Studies in diabetic women have previously reported higher Candida colonization rates, more frequent symptomatic recurrence, and altered response to standard antifungal therapy, especially in the setting of inadequate glycemic control (20-25). The current findings extend those observations by showing that

even women without a prior metabolic diagnosis may already demonstrate a clinically meaningful glycemic gradient when they present with recurrent infection.

The comparison of fasting plasma glucose and HbA1c values between glycemic groups further reinforces this relationship. Women with abnormal glycemic status had substantially higher mean fasting glucose and HbA1c values than those with normal glycemic status, and both measures were significantly associated with recurrence burden. This is consistent with the broader pathophysiological understanding that elevated glucose levels may enhance Candida adherence and proliferation, impair innate immune defenses, and alter the vaginal microenvironment in ways that promote persistence and symptomatic relapse (21,22). Prior work has also suggested that glucose dynamics in vaginal secretions may be influenced by systemic glucose tolerance status, offering a mechanistic explanation for why even prediabetic states may contribute to recurrent disease (19).

The local relevance of these findings is particularly strong in Pakistan, where the burden of undiagnosed dysglycemia remains high. National surveys have documented considerable prevalence of both diabetes and prediabetes, with many cases remaining unidentified until complications or secondary clinical presentations arise (26,27). Data from Balochistan have also shown a longstanding burden of glucose intolerance and impaired fasting glucose in both provincial and rural populations (28-30). In this context, recurrent vulvovaginal candidiasis may represent a valuable clinical entry point for opportunistic metabolic screening, particularly in tertiary care settings where women often present after repeated empirical treatment, delayed diagnosis, or unsuccessful management at peripheral centers.

Another important implication of this study is its relevance to routine gynecology practice. Recurrent vaginal symptoms are often managed symptomatically, with repeated antifungal prescriptions based largely on clinical presentation alone. However, the current findings suggest that such an approach may be incomplete in a substantial subset of patients. If nearly one in two women with recurrent candidiasis has previously unrecognized dysglycemia, then repeated symptom-based treatment without glycemic evaluation may fail to address a major driver of recurrence. This reinforces the need for a more integrated clinical strategy in which microbiological confirmation and metabolic screening are both considered in women with three or more episodes within one year.

The study should also be interpreted in light of its methodological limitations. Because the design was analytical cross-sectional, the findings establish association rather than temporal causality. It cannot be confirmed from the present data whether dysglycemia preceded recurrence in every case or whether both conditions were influenced by shared risk factors such as obesity, recent antibiotic exposure, hygiene-related practices, or species-specific Candida variation. In addition, the study was conducted in a tertiary care setting, which may have enriched the sample with more severe or treatment-resistant cases and may therefore limit generalizability to primary care populations. Even so, the consistency of the observed pattern across categorical distribution, mean glycemic comparisons, and recurrence gradients supports the robustness of the central clinical message.

Overall, the present study contributes meaningful local evidence to an area of important gynecologic and metabolic overlap. It indicates that recurrent vulvovaginal candidiasis in this setting should not be viewed solely as a repetitive infectious complaint, but also as a potential marker of hidden dysglycemia. Future multicenter and prospective studies should explore whether structured glycemic screening and early metabolic intervention in women with recurrent candidiasis can reduce recurrence frequency, improve treatment response, and support earlier detection of prediabetes and diabetes in women's health services.

CONCLUSION

Recurrent vulvovaginal candidiasis was strongly associated with abnormal glycemic status in women attending a tertiary care gynecology clinic, and nearly half of the affected patients had previously

unrecognized prediabetes or diabetes-range values. Women with worse glycemic categories experienced a greater burden of recurrent episodes, while mean fasting plasma glucose and HbA1c were significantly higher among those with dysglycemia. These findings suggest that recurrent candidiasis may serve as a clinically useful marker of underlying metabolic disturbance and support the incorporation of opportunistic fasting glucose and HbA1c screening into the routine evaluation of women presenting with recurrent vulvovaginal candidiasis, particularly in high-burden settings such as Balochistan.

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