

OPEN ACCESS



Comparison of Behavior Therapy versus Combination Therapy, Solifenacin with Behavior Therapy in the Management of the Nocturnal Enuresis

Imran Qadir¹, Muhammad Talha², Hassan Uzman³, Eisha Jannat Khan⁴, Firasat Majid⁵, Sayed Elyas⁶, Muhammad Imran Sohail⁷

	Authors' Contribution
1 Associate Professor, Department of Pediatric Urology, Children Hospital, Faisalabad Pakistan	Protocol/project conception and design
2 Post Graduate Resident, Department of Pediatric Medicine, Children Hospital, Faisalabad Pakistan	Manuscript writing and proof reading
3 Medical Officer, Department of Pediatric Medicine, Children Hospital, Faisalabad Pakistan	Data acquisition
4 Resident Medical Officer, Department of Neonatology, National Hospital, Faisalabad Pakistan	Analysis and data interpretation
5 Associate Professor, Department of Pediatric Urology, The Kidney Center Quaid-I-Azam Medical College, Bahawalpur Pakistan	Discussion and conclusion Evaluation
6 Post Graduate Resident, Department of Pediatric Surgery, Children Hospital, Faisalabad Pakistan	Data collection & communication with patient
7 Deputy Medical Superintendent, Children Hospital Faisalabad Pakistan	Data curation and validation & final visualization
Dr. Imran Qadir Correspondence: Associate Professor, Department of Pediatric Urology, Children Hospital, Faisalabad Pakistan Email: drimranqadir@yahoo.com	
Submitted for Publication: 20-01-2026 Revision Received: 28-04-2026 Accepted for Publication: 04-05-2026	

ABSTRACT

Background: Nocturnal enuresis (NE), known as bedwetting, is a common problem with psychosocial challenges, if not properly managed, defined as the involuntary urine leakage during sleep. **Objective:** Outcomes comparison in the management of behavior therapy VS combination therapy, solifenacin with behavioral-therapy in children with bedwetting. **Study Design:** Randomized-controlled trial. **Settings:** Departments of Pediatric Urology, Children's Hospital, Faisalabad Pakistan. **Duration:** Six months (01-04-2025 to 30-09-2025). **Methods:** The study was conducted with a comparison of two groups: group A consisted of patients with behavior therapy management alone in NE, while group B consisted of patients managed with combination therapy, Solifenacin with behavior therapy. **Results:** The mean wet nights were decreased in group A (only behavior therapy) to 2.1 ± 1.4 nights/week, while in group B (1.3 ± 1.1 nights/week) were documented when patients took solifenacin with behavior therapy. The reduction was significantly greater in the solifenacin group compared to behavior-therapy ($p=0.02$). Treatment response of group-A 35% achieved complete recovery, 40% had partial recovery, and 25% had no recovery. In comparison with group B, solifenacin with behavior therapy group have 50% complete recovery, 35% achieving partial recovery, and 15% showed no recovery. Although the complete recovery rate was higher in group B, the difference did not have strong statistical significance ($p = 0.08$). **Conclusion:** Both treatments, only behavior therapy and a combination of Solifenacin with behavior therapy, make the patient dry during sleep. Combination therapy has superior short-term efficacy and compliance. While the behavior therapy alone has lower recurrence and less pharmacological side-effects.

Keywords: Nocturnal enuresis, Bedwetting, Solifenacin, Behavior therapy.

How to Cite: Qadir I, Talha M, Uzman H, Khan EJ, Majid F, Elyas S, Sohail MI. Comparison of Behavior Therapy versus Combination Therapy, Solifenacin with Behavior Therapy in the Management of the Nocturnal Enuresis. APMC 2026;20(2):72-76. DOI: 10.29054/APMC/2026.1877

This is an open access article distributed under the terms of the Attribution Creative Commons-Noncommercial (CC BY-NC 4.0) (<https://creativecommons.org/licenses/by-nc/4.0/>), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

INTRODUCTION

Nocturnal Enuresis (NE) is a medical term that is usually used for bedwetting. It is very common as well as a psychological and social challenge for the children and the parents, if not treated well. This problem is defined when a child voids involuntarily during sleep. If there are no other symptoms other than bedwetting, then it is classified as primary monosymptomatic nocturnal enuresis (PMNE), while if there are any other symptoms that coexist with bedwetting, then it is called non-monosymptomatic nocturnal enuresis (nMNE), these symptoms may be daytime lower urinary tract symptoms. NE may exist due to many factors, such as decreased bladder capacity, nocturnal polyuria, and elevated arousal thresholds.

Management approaches consist of behavioral interventions and pharmacological treatments.¹

Treatment of non-pharmacological interventions includes behavioral therapy, alarm conditioning, and structured bladder training. These are the baseline treatments for NE because it helps in dry nights through lifestyle modification and supportive methods. A term like Alarm therapy, where the child wakes up when the device detects a few drops of urine, and helps to avoid relapses, as compared to treating medication. However, its success depends on ongoing commitment from both the child, caretaker, and associated family members.²

On the other hand, pharmacological treatment is designed to address the physiological causes of enuresis. A synthetic analogue of the vasopressin, known as Desmopressin, has been the preferred medication to help decrease night-time urine production, yet many patients experience only partial improvement with desmopressin alone. To overcome this, combination therapies have been explored. For example, the anticholinergic drug solifenacin can be combined with desmopressin to increase bladder capacity and decrease detrusor muscle overactivity, which may lead to better outcomes than desmopressin monotherapy. In recent years, multiple randomized controlled trials have shown where combination of desmopressin and solifenacin gave results of better outcomes and lower relapse rates compared to desmopressin (only) in children diagnosed with the PMNE.³

Although there is growing evidence supporting combination drug therapies, direct comparisons between behavioral interventions and solifenacin-based pharmacological treatments remain scarce in recent studies. This suggests that we should further study the effect of behavior therapy, Alarm therapy, lifestyle modification, and pharmacotherapy. Each strategy has distinct implications for patient compliance, potential side effects, and long-term outcomes.

Nocturnal enuresis (NE) is defined as a condition in which a child voids involuntarily during sleep at or after the age of four years. It remains a common disease in children, which decreases quality of life, emotional well-being, and creates psychological pressure. We can classify the bedwetting into primary mono-symptomatic nocturnal enuresis (PMNE), where the patient has bedwetting without any other lower-urinary-tract-symptoms (LUTS), and non-mono-symptomatic, where other urinary symptoms like urgency or burning may coexist. The etiology is diverse, containing various factors like nocturnal polyuria, decreased functional bladder capacity, and high arousal thresholds, which alter the mechanism of the voiding system.⁴

In behavior therapy, we train the patient and parents to comply with bladder training, where behavioral modification, psychological support, timed voiding, and habit changes help to improve the symptoms of Nocturnal enuresis. Whereas alarm therapy, motivational reinforcement, and bladder diaries are designed to help the child feel proper fullness and distension of the bladder with the waking process of the urge during sleep. Alarm therapy gives results of about 50–75% and remains as important as first-line non-pharmacologic therapy.⁵

In pharmacologic management, desmopressin gave good results to decrease the symptoms of bedwetting, but discontinuing this drug may lead to disease recurrence in many children. In cases of short bladder capacity, a muscarinic receptor antagonist like solifenacin gives comparable results. There is much research that the combination of desmopressin and solifenacin has better results.⁶

Despite increasing evidence favoring combination pharmacotherapy, direct comparative studies between behavior therapy and solifenacin-based pharmacologic regimens remain scarce. Evaluating the relative efficacy, patient compliance, and side effect profiles of these treatments is crucial for optimizing

personalized care and informing clinical practice in the management of pediatric enuresis.

OBJECTIVE

Outcomes comparison in the management of behavior therapy (alone) versus combination therapy, solifenacin with behavioral therapy in the pediatric population with mono-symptomatic nocturnal enuresis.

OPERATIONAL DEFINITIONS

Behavioral therapy consisted of prompted voiding (timed voiding by clock) during daytime hours, ensuring voiding before bedtime, and restriction of fluid intake before sleep. Counselling of both the child and parents was conducted to minimize stress and maintain a supportive home environment.

Combination therapy included behavioral therapy along with orally administered solifenacin at a dose of 2.5–5 mg given at bedtime.

METHODS

The comparative study was done in the Department of Pediatric Urology, Children Hospital, Faisalabad, from April to September 2025. There are total number of 80 consecutive children, the sample size of 80 patients (40 per group) was calculated using the Epi-Info™ sample size calculator (CDC, USA), based on the WHO-recommended statistical method with 80% power and the 90% of confidence level using parameters derived from previous studies on nocturnal enuresis management outcomes. The patients of our study related to both genders with age from 04 years to 14 years, diagnosed with monosymptomatic nocturnal enuresis, were enrolled using a non-probability convenience sampling technique.

Children having established urinary tract abnormalities or congenital anomalies, acquired urological diseases, active urinary tract infection, neurogenic bladder, or associated daytime urinary urgency were excluded from the study. We took the detailed clinical history followed by physical examination of all the children of the study. We divided the participants of the study into 02 groups; Group-A and Group-B. Where the Group A received behavioral therapy alone. And the Group B received medicine named solifenacin in addition to behavioral therapy.

The Sample size was 80 patients, who were managed with the group A and group B method, with an alternate method of selection. The Management of NE was conducted using two therapeutic approaches, where the first approach involved behavioral therapy, which includes lifestyle modifications and psychological family support. That includes following advice like children were instructed to restrict fluid intake for at least three hours before bedtime, restrict beverages such as coffee, tea, juices, milk, and carbonated drinks in the evening and afterward till sleep.

Caretaker/parents were advised to identify the child's usual time of bedwetting. Then they should wake the child approximately 15 minutes before that time each night. They are advised to do it manually or with the help of an alarm, routinely

throughout the treatment period. Though punishment, criticism, or teasing of the child at home or school is strictly prohibited by parents and peers. Positive reinforcement, like verbal praise and small rewards and regard after dry nights, should be strongly encouraged.

Daytime, bladder retraining through prompted voiding at fixed intervals was advised to children, under parental supervision to ensure compliance.

The second treatment approach was combination therapy, which included behavioral measures along with pharmacological treatment, named Solifenacin, a muscarinic receptor antagonist. This medicine was given orally, a dose of 2.5–5 mg at bedtime for the management of NE.

Inclusion criteria were the patients' age from 4 years to 14 years, with both genders, with exclusion criteria where the children had urinary tract infection, LUTS, neurogenic bladder, congenital bladder anomalies, and significant post-void residual urine.

Treatment outcomes were categorized into three groups: the first is no response, which means no improvement in symptoms following treatment. Second was improved but not cured, meaning the partial improvement with a reduction in the frequency of nocturnal enuresis episodes. Third was Cured, i.e., complete resolution of symptoms. The follow-up assessments were conducted at two weeks and four weeks after initiation of treatment.

Following approval from the Hospital Ethical Committee (vide letter no. 18520 dated 25/03/2025), data of the patients were collected from the parents/caretakers, in the outpatient department of the Children Hospital Faisalabad, according to the inclusion criteria and the exclusion criteria. Informed consent (Written) was obtained from the caretaker for treatment and collection of data for research too.

A total eighty children were taken for the research. There were 46 boys (57.5%) and 34 girls (42.5%). The age of the patients was between 4 and 14 years old. Mean age was 8.6 ± 2.1 years. We used a computer-generated random number table. All patients were equally divided into 02 groups. In group A, the quantity of patients was $n = 40$ (50%), who received behavioral therapy alone. Group B was $n = 40$ (50%), and they received a combination therapy of solifenacin with behavioral measures.

Management duration was four weeks, and the response to the treatment was documented in the second and fourth weeks. Data was recorded into three categories of results: no response (0), improvement without cure (1), or complete cure (2). Data were entered into a predesigned proforma. And then the data was analyzed with the help of SPSS version 26. The test name chi-square was also applied to compare outcomes between group A and group B.

RESULTS

Total eighty children have been enrolled in the research with primary monosymptomatic nocturnal enuresis (PMNE). They were randomized equally into a behavior therapy alone group, named group A, and a solifenacin-based pharmacotherapy with

behavior therapy group named group B. The mean age of participant patients was 08.6 ± 2.1 years old, with a male predominance. The demographic characteristics, like age, gender, family history, and baseline frequency of wet nights, were found to be comparable between the two groups. There were no statistically significant differences observed ($p > 0.05$).

The mean number of episodes of bedwetting per week was 4.9 ± 1.2 in the behavior therapy group, while 5.1 ± 1.3 in group B, where the patient was advised solifenacin with behavior therapy, showing no significant difference ($p = 0.47$). After four weeks of NE management, both groups demonstrated a statistically significant reduction in wet-night frequency, compared to baseline symptoms ($p < 0.001$). The mean wet nights were greater in group A (only behavior therapy), which was 2.1 ± 1.4 nights per week, while in group B, 1.3 ± 1.1 nights per week were documented when patients took solifenacin with behavior therapy. The reduction of bedwetting was found to be significantly greater in solifenacin group compared to only behavior therapy ($p = 0.02$).

Table 1: Episodes of bedwetting per week

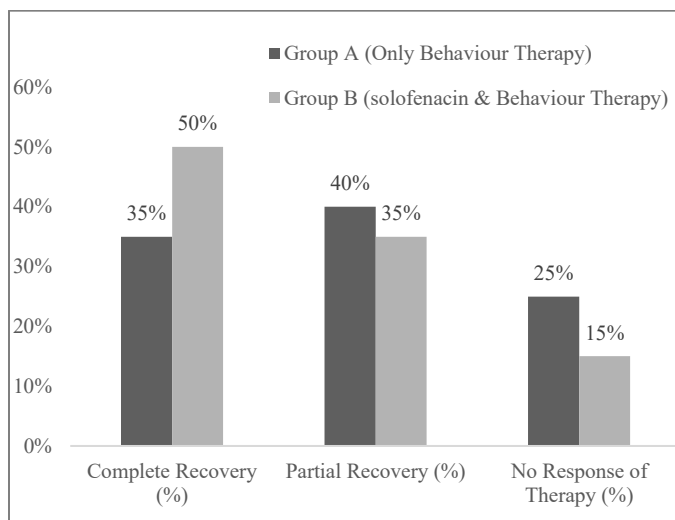
Groups of Patients	No of Episodes of Bed Wetting per Week in Both Groups
Group A (Only Behavior Therapy)	4.9 ± 1.2
Group B (Solifenacin & Behavior Therapy)	5.1 ± 1.3
P Value = 0.47	

Table 2: Outcomes of bedwetting treatment

Groups of Patients	Group A (Only Behavior Therapy)	Group B (Solifenacin & Behavior Therapy)
Number of Complete Recoveries	14	20
Complete Recovery (%)	35%	50%
Number of Partial Recovery	16	14
Partial Recovery (%)	40%	35%
Number of no Response of Therapy	10	6
No Response of Therapy (%)	25%	15%

While assessing the treatment response, in group A behavior therapy alone, the 35% ($N=14$), of children in this group achieved complete recovery, 40% ($N=16$), had partial recovery, and 25% ($N=10$), had no recovery. In comparison with group B solifenacin with behavior therapy group were found a higher complete recovery rate of 50% ($N=20$), while 35% ($N=14$), achieving partial recovery and 15% ($N=6$), showing no recovery. Although the complete recovery rate was higher with solifenacin and behavior therapy group, the difference did not reach statistical significance ($p = 0.08$).

Alternative (more formal): The observed difference was not statistically significant ($p = 0.08$).

Figure 1: Outcomes of bedwetting treatment response

Treatment adherence was found to be higher in group B, which was 85% (N=34), of participants demonstrating good compliance, compared to 65% (N=26) in group A, where patients were advised only of the behavior therapy, while the lower adherence in the behavior therapy group was primarily due to inconsistent use of the alarm and the caregiver fatigue. Indeed, no medical adverse effects were reported in group A, only the behavior therapy group, although some participants experienced transient sleep disturbance. In group B, where solifenacin was used with behavior therapy, there were mild side-effects like mouth dryness and constipation reported in 15% (N=6) of patients, with no severe adverse events or treatment discontinuations.

Table 3: Treatment adherence of bedwetting

Groups of Patients	Number of Patients	Percentage (%)
Group A (Only Behavior Therapy)	26	65%
Group B (Solifenacin & Behavior Therapy)	34	85%

During the four-month follow-up period of the study after completion of the therapy, we found that recurrence of NE symptoms was 12.5% (N=5) in patients of group A, only with behavior therapy, while 22.5% (N=9), patients had recurrence of symptoms in group B i.e., combination therapy. No statistically significant difference was observed between the two groups ($p = 0.19$). Although both treatment modalities were found to be effective in reducing nocturnal enuresis, with combination therapy, solifenacin and behavior therapy demonstrated the superior short-term efficacy and compliance. While the behavior therapy alone showed a trend toward lower recurrence and absence of pharmacological side effects.

DISCUSSION

In our study, we conducted research to compare the outcomes of the management of NE with the behavior therapy method and compare it with the combination therapy with solifenacin along with behavior therapy in patients with the primary mono-symptomatic nocturnal enuresis. We found a significant

decrease in the symptoms of both groups, and lead to dry nights. However, the combination therapy, where solifenacin and behavior therapy produced a more pronounced short-term reduction in wet nights and improved complete recovery rates compared to behavioral therapy alone. The results of these studies align with recent research highlighting the importance of bladder dysfunction. Especially, the reduced functional bladder capacity may lead to the underlying mechanisms of nocturnal enuresis.^{7,8}

The medicine named Solifenacin, this is a selective M3 muscarinic receptor antagonist, which enhances bladder storage by decreasing involuntary detrusor muscle contractions. Due to this, bladder capacity is increased at night. Recent randomized controlled trials have demonstrated that anticholinergic agents like solifenacin provide better outcomes for children who do not respond sufficiently to desmopressin alone or who are suspected to have bladder overactivity.^{9,10} The greater compliance seen in the pharmacotherapy group in this study is consistent with previous research, which indicates that medication-based treatments are generally simpler for families to adhere to than extended behavioral conditioning programs.¹¹

Behavioral therapy, such as bladder training and alarm conditioning, continues to be a fundamental approach in treating nocturnal enuresis and is strongly endorsed as the first-line treatment in international guidelines.⁶ While behavioral therapy showed lower short-term effectiveness compared to solifenacin in this study, it was linked to a lower relapse rate during follow-up. This finding supports existing evidence that alarm-based and behavioral interventions help establish long-term conditioning of arousal responses and bladder control, resulting in more durable benefits even after treatment has ended.^{12, 13}

Side effects observed in the solifenacin group were mild and resolved on their own, which is in line with recent safety data showing that solifenacin is generally well tolerated in children when administered at recommended doses.^{9,10} However, the comparatively higher recurrence rate after stopping medication seen in this study supports the perspective that pharmacological therapy mainly offers symptomatic relief, rather than a lasting cure for enuresis when used alone.

Overall, the findings of our study indicate that treatment should be tailored to the individual child. Solifenacin with behavior therapy is especially useful for children needing fast recovery, while behavioral therapy alone provides a safer alternative with long-lasting results. Recent studies increasingly advocate for a combined behavioral and pharmacological strategy to enhance effectiveness and reduce relapse rates, particularly in cases that do not respond to single therapies.^{8,11}

Onuki studied thoroughly the main outcomes, which measured the occurrence of incontinence. The study assessed various factors, including demographic characteristics, five treatment options (vasopressin, solifenacin succinate, Mirabegron, alarm therapy, and osmotic laxatives), as well as six meteorological variables: daily average ambient temperature, temperature fluctuations, precipitation, hours of sunshine, atmospheric pressure, and humidity.¹⁴ While Zhai's study declares that the Combination-therapy may offer greater effectiveness than

monotherapy in the treatment of bedwetting. The most commonly employed combination regimen includes anticholinergic agents together with desmopressin. Pharmacological treatments used in the management of nocturnal enuresis are generally considered safe.¹⁵

Monsour studied Mirabegron, which has shown greater effectiveness and fewer side effects than solifenacin in treating children with overactive bladder (OAB). Mirabegron not only improves daytime symptoms and nocturnal enuresis but also carries a lower constipation risk. Therefore, it is considered the preferred first-line pharmacological treatment for this patient group.¹⁶

CONCLUSION

Both treatment modalities, behavior therapy (only) and a combination of Solifenacin with behavior therapy, were found effective in reducing nocturnal enuresis; Solifenacin and behavior therapy demonstrated the superior short-term efficacy and compliance. While the behavior therapy alone showed a trend toward lower recurrence and absence of pharmacological side effects.

LIMITATIONS

This study was conducted in a single unit of a big city, which contains data from a single tertiary care hospital only.

In this study, we compared only two treatment options, which is the limitation of the study because there are other methods, treatment options like desmopressin and other modalities like alarm therapy. These all have a significant role in the management of nocturnal enuresis.

SUGGESTIONS / RECOMMENDATIONS

Further studies should be conducted in other tertiary care centres of this city and other big cities too, with collaborations and synergy.

There should be more and extensive study work for treatment options with comparisons of other methods, treatment options like desmopressin and other modalities like alarm therapy, because these all have a significant role in the management of nocturnal enuresis.

CONFLICT OF INTEREST / DISCLOSURE

We all authors declare that there is no conflict of interest regarding the publication of this study. No financial or non-financial support was received from any pharmaceutical company or organization related to solifenacin or other medications used in this research.

FUNDING SOURCE

All resources were used from the hospital. No funding was received from anywhere, the hospital administration, pharmacy

department, and development department supported the researchers.

ACKNOWLEDGEMENTS

The hospital administration, pharmacy department, and development department helped us strategically.

REFERENCES

1. Cai T, Yao Y, Sun W, Lei P. Desmopressin in Combination With Anticholinergic Agents in the Treatment of Nocturnal Enuresis: A Systematic Review and Meta-Analysis. *Front Pediatr.* 2023 Sep 7;11:1242777.
2. Bohra A, Bhatt GC. Evidence-Based Management of Primary Monosymptomatic Nocturnal Enuresis. *Asian J Pediatr Nephrol.* 2022;5(2):69-77.
3. Ahmad T, Minallah N. Comparative Analysis of Solifenacin Plus Desmopressin Versus Desmopressin Alone in the Treatment of Primary Monosymptomatic Nocturnal Enuresis. *J Pediatr Surg.* 2023 Oct;58(10):2034-7.
4. Arda E, Cakiroglu B, Thomas DT. Primary Nocturnal Enuresis: A Review. *Nephrourol Mon.* 2016 Aug;8(4):e35809.
5. Nuzhat H, Qadir I, Malik MTB. Outcome of Combination Therapy Versus Behaviour Therapy in Treatment of Nocturnal Enuresis. *J Univ Med Dent Coll.* 2017;8(4):7-13.
6. Ghanavati PM, Khazaeli D, Amjadzadeh M. A Comparison of the Efficacy and Tolerability of Treating Primary Nocturnal Enuresis With Solifenacin Plus Desmopressin, Tolterodine Plus Desmopressin, and Desmopressin Alone: A Randomized Controlled Clinical Trial. *Int Braz J Urol.* 2021 Jan-Feb;47(1):73-81.
7. Nevés T, von Gontard A, Hoebeke P, Hjalms K, Bauer S, Bower W, et al. Management and Treatment of Nocturnal Enuresis—An Updated Standardization Document From the International Children's Continence Society. *J Pediatr Urol.* 2020 Feb;16(1):10-19.
8. Austin PF, Ferguson G, Yan Y, Campigotto MJ, Royer ME, Coplen DE. Combination therapy with desmopressin and an anticholinergic medication for nonresponders to desmopressin for monosymptomatic nocturnal enuresis: a randomized, double-blind, placebo-controlled trial. *Pediatrics.* 2008 Nov;122(5):1027-32.
9. Raheem AA, El-Sayed ER, El-Ghoneimy MN. Efficacy of Solifenacin Combined With Desmopressin in Children With Primary Monosymptomatic Nocturnal Enuresis. *J Pediatr Urol.* 2021 Jun;17(3):365.e1-365.e7.
10. El-Nahas AR, Abdelrahman MY, Elkholy A. Safety and Efficacy of Solifenacin in Refractory Pediatric Nocturnal Enuresis: A Randomized Trial. *Urology.* 2023 Jun;176:145-51.
11. Butler RJ, Holland P. The Three Systems Model of Nocturnal Enuresis: Implications for Treatment. *Front Pediatr.* 2022 Apr 13;10:865375.
12. Glazener CMA, Evans JHC, Peto RE. Alarm Interventions for Nocturnal Enuresis in Children. *Cochrane Database Syst Rev.* 2020 May 5;(5):CD002911.
13. Huang YS, Chen YT, Tsai JD. Long-Term Outcomes of Alarm Therapy Versus Pharmacotherapy in Pediatric Nocturnal Enuresis. *Pediatr Neonatol.* 2022 Dec;63(6):620-6.
14. Onuki Y, Miyano T, Iwanaka Y, Yamashita S, Hori S, Takahashi K, et al. Effects of Treatment and Weather Variables on Nocturnal Enuresis: Long-Term Analysis Using the Classification and Regression Trees Model. *Cureus.* 2025 Dec;17(12):e98841.
15. Zhai Y, Zhang Y, Gou H. Pharmacological Treatment of Pediatric Nocturnal Enuresis: A Systematic Review and Network Meta-Analysis. *Pediatr Nephrol.* 2025 Sep;40(9):2795-806.
16. Mansour I, Laymon M, Abdelhalim A, Dawaba MS, El-Hefnawy AS. Efficacy and Safety of Mirabegron Compared to Solifenacin in Treatment of Non-Neurogenic Overactive Bladder in Children: A Randomized Controlled Trial. *Int Braz J Urol.* 2025 Mar-Apr;51(2):e20240425.