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Cost-utility and budget impact analysis of desmopressin for treating monosymptomatic nocturnal enuresis in Thai children

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Monosymptomatic nocturnal enuresis (MNE) imposes a notable clinical and psychosocial burden, yet no economic evaluations have been conducted in Thailand. This study conducted the cost-utility analysis (CUA) and budget impact analysis (BIA) of desmopressin acetate compared with imipramine and no treatment in children aged ≥ 7 years with MNE who have not responded to behavioural management and not responded, or expected not to respond, to alarm therapy. A CUA was conducted from a partial societal perspective, and a BIA was undertaken from a payer perspective. Model parameters were source from published evidence and expert opinion. Desmopressin yielded the highest quality-adjusted life years (QALYs) (9.77) and costs ($740.54). The incremental cost-effectiveness ratios were $2,385/QALY versus no treatment and $2,226/QALY versus imipramine, both below Thailand's willingness-to-pay threshold ($4,733.73/QALY). Probabilistic sensitivity analysis indicated a 73.5–74.0% probability of cost-effectiveness. The five-year budget impact of introducing desmopressin was estimated at $26.998 million. These findings suggest that desmopressin may represent a cost-effective option for managing MNE, although its adoption would careful consideration of budgetary implications. The results provide context-specific evidence to inform policy deliberations in Thailand and may offer insights for other low- and middle-income countries.

Keywords Budget impact analysis, Cost–utility analysis, Desmopressin acetate, Monosymptomatic nocturnal enuresis

Monosymptomatic nocturnal enuresis (MNE) is a common pediatric condition that affects child health, family well-being, and healthcare resource use[1]. It is defined as involuntary urination during sleep at least twice a week for three consecutive months in children aged five years or older, without other lower urinary tract symptoms[1,2]. MNE can have broader social and economic consequences, including reduced school attendance, lower self-esteem, and lost caregiver productivity[3–5], as well as physical effects such as skin irritation, rashes, and increased infection risk[6]. Globally, prevalence among children aged five years and older ranges from 5 to 21%, with higher rates in boys[7,8]. In Thailand, the prevalence in children aged 5–15 years is 9.7%[9,10]—around 688,92 children—posing both personal burdens and potential pressures on health system planning and resource allocation[11,12].

Standard management for MNE generally begins with behavioral interventions, followed by alarm therapy or pharmacological treatment if necessary[1]. In Thailand, treatment practices vary due to differences in resources, clinician experience, and family preferences[10]. Imipramine is an established pharmacologic option and is reimbursed under the National List of Essential Medicines (NLEM), although its use requires careful monitoring owing to cardiotoxicity risks[13,14]. Desmopressin is available in tablet and oral lyophilisate (MELT) formulations, offers advantages in adherence and convenience for children[15,16]. However, desmopressin acetate is not included in Thailand's NLEM and therefore is not reimbursed under the Universal Coverage Scheme (UCS), limiting its affordability and widespread use[13].

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Thailand's health system, which relies on a tax-funded universal coverage scheme, centralized procurement, and policy decisions guided by health technology assessment (HTA), provides a well-organized framework for evidence-based decision-making[11,17]. While such a framework could support the efficient and fair adoption of new interventions, decisions require evidence that reflects local clinical practice, cost structures, and policy priorities[17,18]. Economic studies from high-income countries, including the National Institute for Health and Care Excellence (NICE) in the United Kingdom[19], have found desmopressin to be cost-effective for MNE. Still, their conclusions cannot be applied directly to Thailand because of differences in healthcare financing, treatment pathways, and willingness-to-pay (WTP) thresholds[20].

To address this evidence gap, this study examined the economic and budgetary implications of alternative treatment strategies for children with MNE in the Thai context. The findings aim to provide evidence relevant to national policy deliberations. They may also offer transferable lessons for other low- and middle-income countries (LMIC) with comparable governance and health financing structures.

Methods

A cost-utility analysis (CUA) and a budget impact analysis (BIA) were undertaken to evaluate the cost-effectiveness and budgetary implications of treatment strategies for MNE in Thai children. The CUA adopted a partial societal perspective and the BIA adopted a payer's perspective, in accordance with Thailand's HTA guidelines[18]. Caregiver productivity losses were excluded due to the lack of robust Thai-specific data, and patient productivity losses were excluded to avoid double counting with QALYs.

Three treatment strategies were compared:

1. First-line desmopressin acetate, followed by imipramine for patients who did not achieve a complete response; those who did not respond to imipramine transitioned to the no-treatment arm.
2. First-line imipramine, with non-responders transitioning directly to the no treatment arm.
3. No treatment.

In this analysis, the no-treatment arm was defined as a minimal-pharmacologic-care scenario that reflects current real-world management in Thailand. In cases where children do not achieve sufficient symptom improvement with behavioural advice and, where appropriate, a trial of alarm therapy, pharmacologic treatment may be considered; however, many ultimately remain without pharmacologic therapy because desmopressin is not reimbursed and imipramine use is often limited in practice due to safety concerns. Consequently, a substantial number of children continue with routine clinical follow-up without initiating any pharmacologic therapy. This comparator therefore represents the prevailing care pathway and enables evaluation of both clinical substitution (desmopressin vs. imipramine) and reimbursement-related scenarios (desmopressin vs. no treatment).

The protocol was approved by the Institutional Review Board (IRB) of the Faculty of Medicine, Chulalongkorn University, Bangkok, Thailand (IRB No. 0386/66). The study complied with international ethical standards for human research, including the Declaration of Helsinki, the Belmont Report, the Council for International Organizations of Medical Sciences Guidelines, and the International Conference on Harmonization – Good Clinical Practice (ICH-GCP).

Model structure

A Markov model was developed to simulate the costs and outcomes of children with MNE in Thailand. The model followed a hypothetical cohort from age seven to age twenty, corresponding to a 13-year time horizon. Age seven was chosen as the point at which the model begins, reflecting the stage in clinical care when children have already received behavioural advice without adequate improvement and have either not responded, or are clinically expected not to respond, to alarm therapy, and are now being considered for pharmacologic management.

The time horizon was extended to age twenty to capture the period in which clinically meaningful differences in treatment response, relapse, and spontaneous remission are expected. Beyond late adolescence, persistent MNE becomes uncommon, and further extension of the horizon would add uncertainty without materially affecting the results. The model structure was adapted from the NICE evaluation[19] and modified to reflect the Thai context.

A 3-month cycle length was selected to match routine clinical follow-up intervals, allowing regular assessment of treatment response, possible relapse, and changes in disease status[19]. The analysis was conducted in line with the Thai health technology assessment (HTA) guidelines[18].

The model included four mutually exclusive health states: (i) bedwetting, (ii) partial response (PR), (iii) dry state while on maintenance treatment, and (iv) dry state achieved through natural resolution. For this analysis, "success" was defined as remaining dry for at least 12 consecutive months, whether achieved with treatment or by spontaneous remission.

At baseline, all patients entered the model in the bedwetting state. After the first 3-month treatment cycle, patients could move to one of three categories: complete response (CR), partial response (PR), or no response (NR). Those with CR moved to the dry (on maintenance treatment) state, with the possibility of transitioning to the natural resolution state or relapsing to bedwetting. If relapse occurred, patients re-entered treatment for another 3-month cycle. PR patients continued maintenance therapy for an additional cycle; if CR was still not achieved, they switched to a second-line treatment. Patients with NR proceeded directly to second-line therapy, and if they still did not respond, they remained in the bedwetting state until spontaneous resolution.

Key assumptions were that: (i) patients who achieved CR in the first cycle discontinued therapy at the end of that cycle, following usual clinical practice[1,19]; (ii) relapse rates were treatment-specific; and (iii) patients who became dry remained at risk of spontaneous relapse until they met the 12-month "success" definition.

Internal validation was conducted through equation checking, Markov trace inspection, and extreme-value testing to ensure numerical stability and internal consistency of model behaviour, following established best practices for validation of health economic models[21,22]. External validation was not feasible due to the absence of longitudinal Thai datasets and the lack of previously published economic models relevant to MNE in the Thai context. Conceptual and face validation were undertaken through structured consultations with pediatric clinicians and health economists, which confirmed the clinical credibility and structural plausibility of the model.

Transition probabilities

Clinical inputs for treatment efficacy and natural history were obtained from the most robust and population-relevant sources available. Preference was given to studies with high methodological quality and direct applicability to children with MNE, to maximise internal validity and minimise bias from heterogeneous populations. For treatment efficacy, desmopressin parameters were derived from a network meta-analysis[23]. The study included a subgroup analysis specific to the MNE population. Imipramine efficacy estimates were extracted from the NICE economic evaluation[19], which also focused on children with MNE. Using these aligned sources ensured that both treatment arms reflected comparable patient characteristics, reducing the risk of bias from differences in baseline risk or disease definition.

When studies reported only aggregated response rates (complete plus partial response, CR + PR), the probability of partial response was calculated by subtracting the complete response proportion from the total response rate. Natural history parameters—particularly spontaneous resolution without active treatment—were obtained from the NICE study[19], which drew upon a high-quality longitudinal cohort study by Butler and Heron[8]. This study provided the longest available follow-up and reliable age-specific remission rates, making it suitable for extrapolation over the 13-year model horizon.

The placebo response rate was assumed to equal the 3-month spontaneous resolution rate for 7-year-old children with MNE. It was assumed that 25% of placebo responders achieved a complete response, with the remainder classified as partial responders. All transition probabilities used in the model are summarised in Table 1.

Costs

Costs were categorized into direct medical and direct non-medical costs. Direct medical costs included drug costs, laboratory tests, medical services, specialist consultations, and outpatient treatment. Direct non-medical costs included patient and caregiver food and transportation associated with hospital visits. Costs were estimated by multiplying the number of outpatient visits within each treatment pathway by the corresponding unit-cost values from the Thai Standard Cost List[24]. Indirect costs, such as productivity losses, were excluded from the partial societal perspective due to the absence of reliable Thai-specific data and to avoid potential double counting with QALYs. Healthcare resource use was obtained from King Chulalongkorn Memorial Hospital through structured interviews with pediatric urologists and nurses to ensure that estimates reflected typical patterns of care in the Thai context.

Behavioural advice and any trial of alarm therapy were not costed because these steps occur before the pharmacologic decision point and are common to all treatment strategies. Routine counselling delivered during outpatient visits is already captured within the standard outpatient visit cost applied across all arms. For the no-treatment arm, only routine outpatient follow-up and symptomatic management (e.g., treatment of diaper rash when needed) were costed, consistent with minimal-care practice rather than a natural-history scenario.

Unit costs were sourced from the Thai Standard Cost List[24]. All costs were calculated in Thai Baht (THB) and converted to U.S. dollars (USD) at the 2024 exchange rate of 1 USD = 33.80 THB, as reported by the Bank of Thailand, to facilitate international comparability. Table 1 summarizes the cost parameters used in the analysis.

Outcomes

The health outcome was quality-adjusted life years (QALYs), calculated by multiplying the time spent in each health state by the utility weight. Life years in each state were projected from the Markov model. Utility weights were assigned to four mutually exclusive health states: (i) bedwetting, (ii) partial treatment response, (iii) dryness while on active medication, and (iv) dryness after discontinuation of treatment (natural resolution)[19]. This classification distinguished between treatment-dependent and treatment-independent improvement, ensuring that quality-of-life gains were accurately captured. All utility inputs were sourced from children with MNE conducted by NICE. Utility weights were derived using validated pediatric health-related quality-of-life instruments, with valuation methods consistent with time trade-off techniques[19]. Table 1 presents the final utility values and data sources used in this analysis.

Cost-utility analysis

All costs and health outcomes were presented in 2024 USD. Both costs and QALYs were discounted at an annual rate of 3%. The incremental cost-effectiveness ratio (ICER) was calculated as the difference in total costs divided by the difference in total QALYs between each intervention and its comparator. Analyses were conducted for: (i) desmopressin acetate versus no treatment, and (ii) desmopressin acetate versus imipramine. The willingness-to-pay (WTP) threshold of 160,000 THB per QALY (approximately USD 4,733.73 per QALY), as recommended in the Thai HTA guidelines, was used as the primary benchmark for determining cost-effectiveness in this study[18]. No subgroup or heterogeneity analyses were performed due to insufficient granularity in the available clinical and cost data for stratification by variables such as age, sex, or baseline symptom severity.

Parameters	Values	Range	Distribution	References
Probability of drug response				
Probability of complete response with desmopressin	0.537	0.161–0.650	Beta	[23]
Probability of partial response with desmopressin	0.316	–	Beta	[23]
Probability of complete response with imipramine	0.083	0.016–0.323	Beta	[25]
Probability of partial response with imipramine	0.657	–	Beta	[23,25]
Probability of experiencing recurrence of bedwetting following complete response every 3 months				
Desmopressin acetate				
Recurrence at 1 week	0.2500	–	Beta	[25]
Recurrence at 3 months	0.4167	–	Beta	[25]
Imipramine				
Recurrence at 1 week	0.3555	–	Beta	[25]
Recurrence at 3 months	0.7021	–	Beta	[25]
Probability of transitioning from bedwetting state to dry state through natural resolution every 3 months				
Dry without treatment Year 6.5	0.1319	–	Beta	[25]
Dry without treatment Year 7.5	0.1035	–	Beta	[25]
Dry without treatment Year 10	0.0471	–	Beta	[25]
Dry without treatment Year 11	0.0174	–	Beta	[25]
Dry without treatment Year 12	0.0634	–	Beta	[25]
Dry without treatment Year 13	0.0107	–	Beta	[25]
Dry without treatment Year 14+	0.0369	–	Beta	[25]
Probability of relapse to bedwetting state every 3 months				
Bedwetting recurrence Year 6.5	0.0119	–	Beta	[25]
Bedwetting recurrence Year 7.5+	0.0032	–	Beta	[25]
Utilities				
No bedwetting	1	–	Beta	[25]
Bedwetting	0.896	–	Beta	[25]
No bedwetting during treatment	0.926	–	Beta	[25]
Partial response to treatment	0.911	–	Beta	[25]
Direct medical cost (USD)				
Imipramine 25 mg (tablet)	0.0163	0.01304–0.01956	Gamma	[33]
Desmopressin 120 mcg (tablet)	3.17	2.536–3.804	Gamma	[33]
Outpatient department medical services (1 time)	10.47	8.38–12.56	Gamma	[24]
Laboratory test for urinalysis (1 time)	2.49	1.99–2.99	Gamma	[24]
Laboratory test for electrolyte analysis (1 time)	3.99	3.19–4.79	Gamma	[24]
Laboratory test for electrocardiography (1 time)	10.00	8.00–12.00	Gamma	[24]
Dispensing service (1 time)	2.51	2.01–3.01	Gamma	[24]
Hospital outpatient service (1 time)	2.49	1.99–2.99	Gamma	[24]
Drug for rash treatment (1 time)	1.9231	1.5385–2.3077	Gamma	Market price
Direct nonmedical cost (USD)				
Traveling cost (1 time)	5.27	4.22–6.32	Gamma	[24]
Additional food cost (1 time)	1.95	1.56–2.34	Gamma	[24]
Budget impact analysis parameters				
Children aged 7–15 years	7,098,883	–	–	[12]
Children aged 7 years	740,186	–	–	[12]
Prevalence of bedwetting in Thailand (%)	9.70	8.5–11.1	–	[9]
Incidence of bedwetting in Thailand (%)	3.4	–	–	[9] and expert opinion

Continued

Parameters	Values	Range	Distribution	References
Patients diagnosed as requiring treatment for nocturnal enuresis (%)	25.00	–	–	Expert opinion
Monosymptomatic nocturnal enuresis (%)	68.50	–	–	[34]
Patients eligible for treatment (%)	33.33	–	–	Expert opinion
Desmopressin treatment duration (months)	3	3–6	–	Expert opinion
Uptake rate (year 1–5) (%)	20–100	Slow uptake: 10–50; Fast uptake: 30–100	–	Assumption

Table 1. Parameters in this study. This table summarizes all input parameters used in the Markov model for both the cost-utility and budget impact analyses. The parameters include transition probabilities, utility weights for different health states, direct medical and non-medical costs, and national demographic data for Thailand. All costs are presented in 2024 U.S. dollars (USD). The range, probability distribution, and data source are provided for each parameter used in the sensitivity analyses.

Sensitivity analysis

To assess model robustness and parameter uncertainty, a structured, multi-step sensitivity analysis was conducted. First, a one-way sensitivity analysis was performed to identify parameters with the greatest influence on the ICER, and results were presented using a tornado diagram. Second, a threshold analysis was undertaken to determine the imipramine complete-response rate at which the treatment would become cost-effective under the Thai WTP threshold. Given the wide variation in published efficacy estimates for imipramine across heterogeneous study populations, this analysis provided an additional assessment of the stability of the comparative cost-effectiveness conclusions.

Third, a scenario analysis examined the impact of alternative data sources on model results. In this analysis, the base-case imipramine efficacy from the NICE study[25]—restricted to the MNE population—was replaced with estimates from the network meta-analysis by Zhai et al.[23], which included a nocturnal enuresis population. This allowed explicit evaluation of how differences in population specificity could influence comparative outcomes.

Finally, a probabilistic sensitivity analysis (PSA) using 1,000 Monte Carlo simulations simultaneously varied all model inputs according to their assigned probability distributions. Parameter uncertainty was characterized using appropriate probability distributions: beta for probabilities and utility, gamma for cost parameters. PSA results were presented on a cost-effectiveness plane and as a cost-effectiveness acceptability curve (CEAC), illustrating the probability of each intervention being cost-effective across a range of WTP thresholds.

Budget impact analysis

A five-year budget impact analysis (BIA) was conducted to estimate the financial consequences of adopting desmopressin acetate for the management of MNE in Thailand, following the methodological principles of the Thai HTA Guidelines[18]. The analysis was performed from the payer perspective, consistent with budgeting processes under the UCS. Eligible patient numbers were calculated using national demographic statistics, the age-specific prevalence of bedwetting in Thailand[9,12], and expert clinical opinion to estimate the proportion requiring treatment. In Year 1, the analysis included all eligible children aged 7–15 years; in Years 2–5, an incidence-based approach was applied based on the annual number of children aged seven years.

The BIA estimated the total annual and cumulative costs of adopting desmopressin, including drug costs, outpatient visits, routine laboratory monitoring, and dispensing services, as specified in Table 1. All costs were reported in undiscounted form, in accordance with ISPOR BIA guidance[26]. Scenario analyses varied key parameters, including uptake rate, drug price, prevalence, and treatment duration, to examine their impact on the total budget impact.

Results

Cost-utility analysis

Desmopressin acetate generated the highest total cost ($740.54 per patient) but also yielded the greatest health gains, with 9.7651 QALYs accrued over the 13-year horizon. From a partial societal perspective, the incremental cost-effectiveness ratio (ICER) for desmopressin acetate was $2,385.37 per QALY gained versus no treatment, and $2,226.17 per QALY gained versus imipramine. Both ICERs were fell below Thailand's WTP threshold of $4,733.73/QALY (Table 2), indicating that desmopressin acetate is cost-effective under current national criteria.

Sensitivity analysis

One-way and threshold sensitivity analysis

One-way and threshold analyses – In the comparison with imipramine, the ICER was most sensitive to four parameters: the probability of complete response to desmopressin, the probability of complete response to imipramine, the unit cost of desmopressin acetate, and the discount rate (Fig. 1). Treatment efficacy parameters had the largest effect, with higher complete response to desmopressin lowering the ICER, and higher complete response to imipramine raising it. Threshold analysis showed that desmopressin remained the preferred option unless the complete response probability for imipramine exceeded 14%, well above the base-case value of 8.3% (Fig. 2).

Parameters	No Treatment	Imipramine	Desmopressin Acetate
Total Cost (USD)	127.70	177.43	740.54
QALYs	9.5082	9.5122	9.7651
ICER (USD/QALY gained)	Reference	Reference	2,385.37* and 2,226.17**

Table 2. Budget impact analysis results. The table presents the primary outcomes of the cost-utility analysis, showing the total costs, total Quality-Adjusted Life Years (QALYs), and the Incremental Cost-Effectiveness Ratio (ICER) for each treatment strategy over a 13-year time horizon. Costs are reported in 2024 U.S. dollars. The ICER values for desmopressin acetate are calculated against two comparators. *Compared to no treatment. **Compared to imipramine.

Probabilistic sensitivity analysis (PSA)

PSA was conducted to assess parameter uncertainty, with results displayed on the cost-effectiveness plane (Fig. 3) and summarised using the CEAC (Fig. 4). At Thailand's WTP threshold, the probability that desmopressin was cost-effective was 73.5–74.0%, as derived from the CEAC. Across a broad range of WTP values, the CEAC indicated that desmopressin consistently had the highest probability of being the most cost-effective option.

Scenario analysis

Substituting MNE-specific efficacy data with estimates from a nocturnal enuresis population reversed the base-case conclusions: imipramine became more cost-effective, yielding 9.6950 QALYs at a total cost of $189.84, compared with 9.6463 QALYs at $727.15 for desmopressin acetate. In this scenario, desmopressin was dominated, being both more costly and less effective.

Budget impact analysis

Over the five-year period, desmopressin acetate yielded the highest total budget impact among the three strategies assessed (Table 3). The cumulative cost of desmopressin was USD 26.998 million, compared with USD 2.237 million for imipramine and USD 0.973 million for the no-treatment option. Annual expenditures for desmopressin were highest in all years, corresponding to its unit price and modeled uptake assumptions.

Scenario analyses showed variation in the five-year budget impact of desmopressin across alternative parameter values (Table 4). Lower uptake and reduced drug price resulted in lower total costs, while higher prevalence estimates and longer treatment duration produced higher cumulative expenditures. The direction and magnitude of changes across scenarios were consistent with the parameter adjustments applied.

Discussion

In the base-case analysis, desmopressin acetate generated higher QALY gains than imipramine or minimal pharmacologic care, with ICERs that remained below Thailand's WTP threshold. Sensitivity analyses showed that results were most influenced by treatment efficacy parameters, and the PSA indicated a 73.5–74.0% likelihood that desmopressin would be considered cost-effective. Scenario analyses showed that the results were sensitive to the efficacy inputs. From the payer perspective, desmopressin was associated with the highest five-year budget impact (USD 26.998 million), highlighting the need to consider affordability when assessing its potential adoption.

The PSA results indicate that desmopressin has a favourable likelihood of being cost-effective across plausible variations in key clinical and economic parameters, although some uncertainty remains. The cost-effectiveness conclusions were broadly consistent across the parameter ranges explored, while still reflecting the inherent limitations of the available evidence and the need for continued monitoring as new data emerge. When interpreting these uncertainty estimates, it is also important to consider the associated budget impact, particularly if desmopressin were to be incorporated into routine practice[27,28]. Policy tools such as risk-sharing arrangements, real-world outcome monitoring, or periodic price review may help manage uncertainty and support more sustainable adoption[29,30].

Interpreting the cost-effectiveness results also requires consideration of the two distinct decision contexts assessed in this study. The comparison between desmopressin and imipramine reflects a clinical substitution scenario among children for whom pharmacologic therapy is already indicated. In contrast, the comparison between desmopressin and minimal pharmacologic care represents a reimbursement decision in a setting where desmopressin is not currently covered under the NLEM. Distinguishing these contexts is important because they carry different policy implications: one concerns selecting the preferred pharmacologic option, whereas the other concerns whether to introduce public coverage for a treatment not currently reimbursed.

The present analysis aligns with the direction of the NICE evaluation for children who begin treatment at around 7 years of age, for whom desmopressin was suggested to be a potentially efficient option when alarm-based interventions are unsuitable or insufficient[19]. Although the NICE conclusions rely on evidence with important limitations and were generated in a different health-system context, they provide a relevant point of reference for interpreting the economic implications of desmopressin use. By incorporating Thai-specific costs, clinical practice patterns, and epidemiologic assumptions, the current study extends this international evidence into a locally applicable framework for decision-making in Thailand.

Several limitations should be considered when interpreting these findings. The analysis relied on non-Thai sources for key parameters, including utilities and transition probabilities, because of limited local evidence. Although formal external validation was not feasible, internal validity checks, face validation with clinical

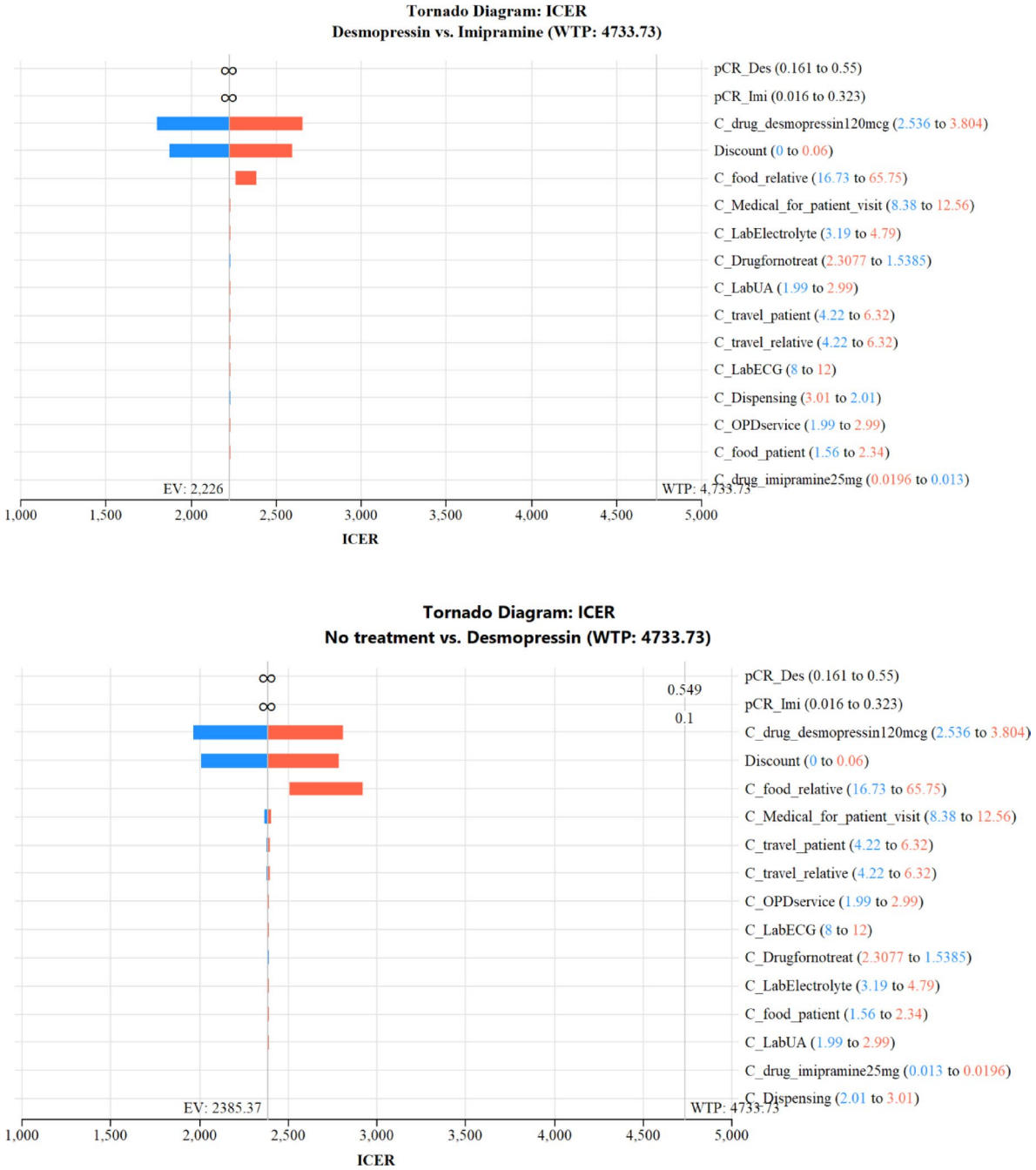

Fig. 1. Tornado diagrams. This figure displays the results of the one-way sensitivity analysis for Desmopressin acetate against its two comparators, utilizing the Thai willingness-to-pay (WTP) threshold of $4,733.73 per Quality-Adjusted Life Year (QALY) gained. Panel A (Desmopressin vs. Imipramine) and Panel B (No treatment vs. Desmopressin) both illustrate the influence of key parameters on the ICER, with the horizontal bars representing the range of the resulting ICER when model inputs are varied across their plausible ranges. The diagram confirms that the ICER is most sensitive to Probability of Complete Response (pCR_Des and pCR_Imi), the Discount Rate, and the Unit Cost of Desmopressin (C_drug_desmopressin120mcg). This visual representation reinforces that the cost-effectiveness conclusions regarding Desmopressin remain robust across the tested range of parameter uncertainty, as none of the varied parameters caused the ICER to cross the WTP threshold.

experts, and extensive sensitivity analyses were conducted to assess the credibility of the model. Treatment efficacy inputs were obtained from two systematic reviews, which introduces some uncertainty related to methodological differences and heterogeneity in study populations. In addition, the partial societal perspective did not include caregiver productivity losses due to the lack of reliable Thai-specific data; however, scenario analyses were undertaken to explore the potential implications of this exclusion. Future research incorporating

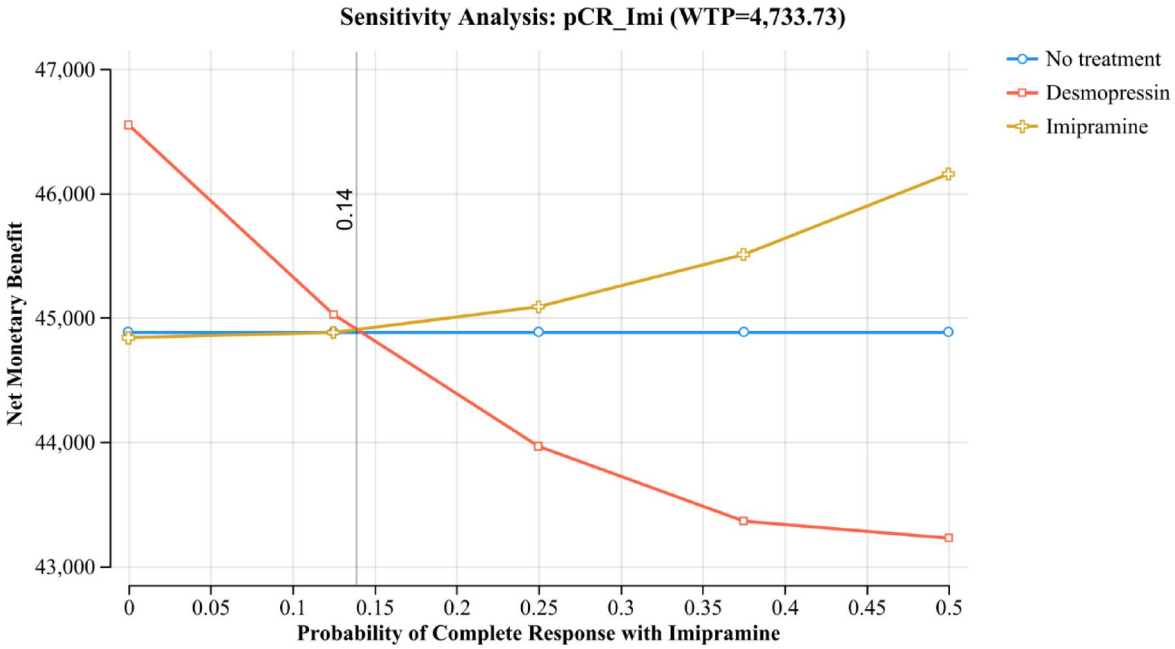

Fig. 2. One-way sensitivity analysis. This graph displays a one-way sensitivity analysis showing how the Net Monetary Benefit of the three treatment strategies (No treatment, Desmopressin, Imipramine) changes as the probability of complete response with imipramine varies. The analysis uses Thailand's willingness-to-pay (WTP) threshold of $4,733.73 per QALY. The vertical line indicates the threshold at which desmopressin is no longer the most cost-effective option. This occurs if the probability of complete response with imipramine exceeds 14%, which is substantially higher than the base-case value of 8.3% used in the model.

local clinical outcomes, preference-based quality-of-life data, and real-world patterns of care would strengthen the applicability of economic evaluations for policy decisions in Thailand.

The findings may also offer insights for other LMICs with similar governance and financing structures, although local adaptation will be necessary to reflect country-specific differences in costs, service delivery, and WTP thresholds[20]. Because the unit cost of desmopressin is an important determinant of cost-effectiveness—alongside other clinical and economic parameters—price-negotiation mechanisms such as pooled procurement or volume-based arrangements may be considered to enhance affordability and help manage the budget impact[31]. System-level considerations, including maintaining reliable access within hospital procurement systems, ensuring that clinicians are well-equipped to evaluate and manage MNE appropriately, and supporting clear referral pathways, may further influence the feasibility of expanding access[32]. Taken together, these considerations underscore the potential for evidence-informed, context-appropriate strategies to support equitable and sustainable access to effective MNE treatments in Thailand and across comparable LMIC settings[32].

Conclusions

Desmopressin acetate was found to be cost-effective relative to both imipramine and no treatment at Thailand's current WTP threshold for children aged seven years and older with MNE who have not responded, or are unlikely to respond, to behavioural and alarm therapies. Multiple factors influenced the economic results, including treatment efficacy and drug cost, with price assumptions contributing substantially to the projected budget impact. Overall, the findings provide context-specific evidence that may support policy deliberations regarding potential treatment options for managing persistent MNE within the Thai healthcare system, while underscoring the need to balance considerations of cost-effectiveness, affordability, and real-world implementation.

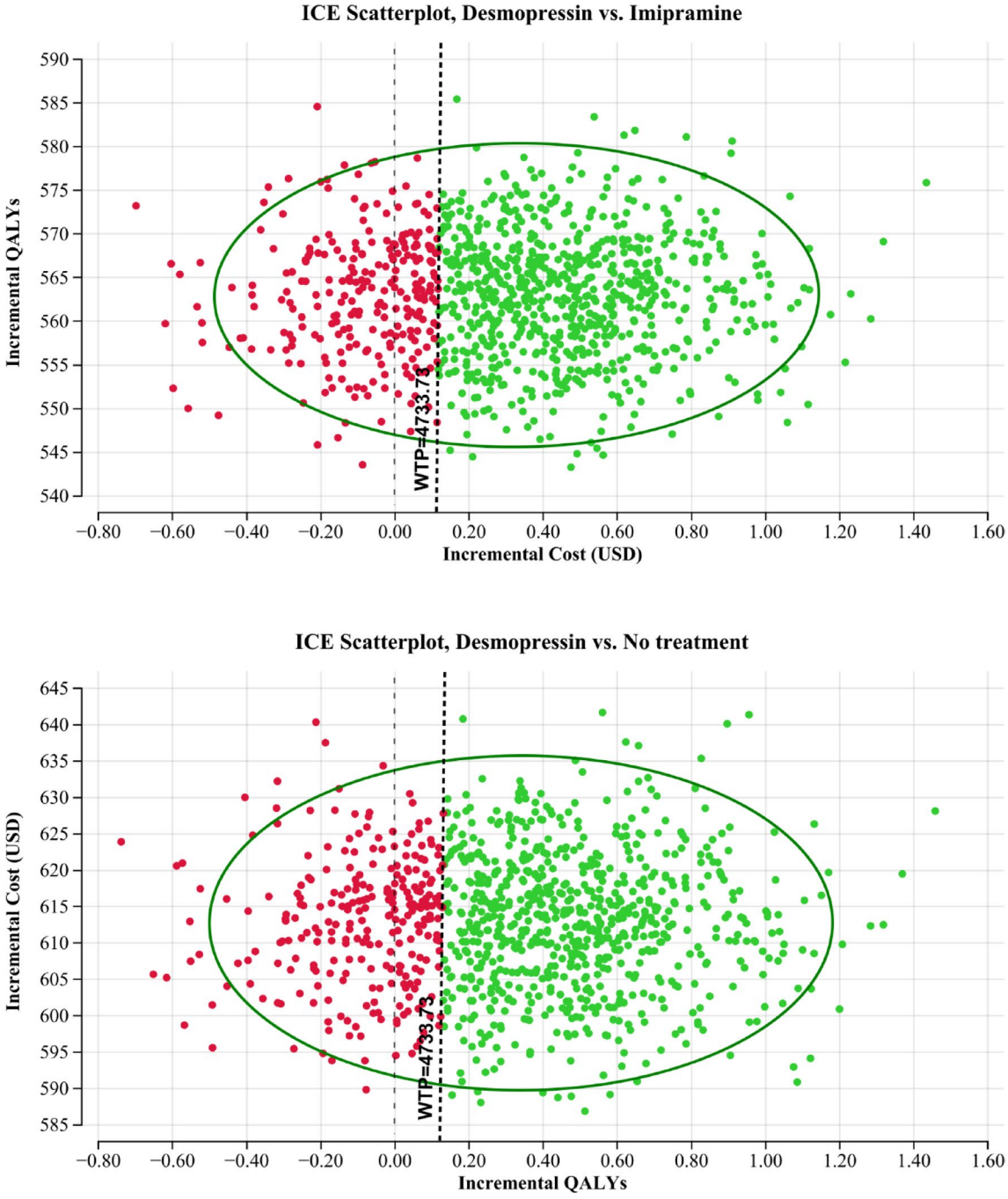

Fig. 3. Incremental cost-effectiveness scatterplot. The scatterplot displays the results of the probabilistic sensitivity analysis (PSA) with 1000 Monte Carlo simulations. Each point represents the incremental cost (y-axis) and incremental Quality-Adjusted Life Years (QALYs) (x-axis) for one simulation. The top panel compares desmopressin to imipramine, and the bottom panel compares desmopressin to no treatment. The dashed line represents Thailand's willingness-to-pay threshold ($4,733.73/QALY). Points to the right of this line are considered cost-effective. The distribution of points indicates that in the majority of simulations, desmopressin was more effective and fell within the cost-effective range compared to both imipramine and no treatment.

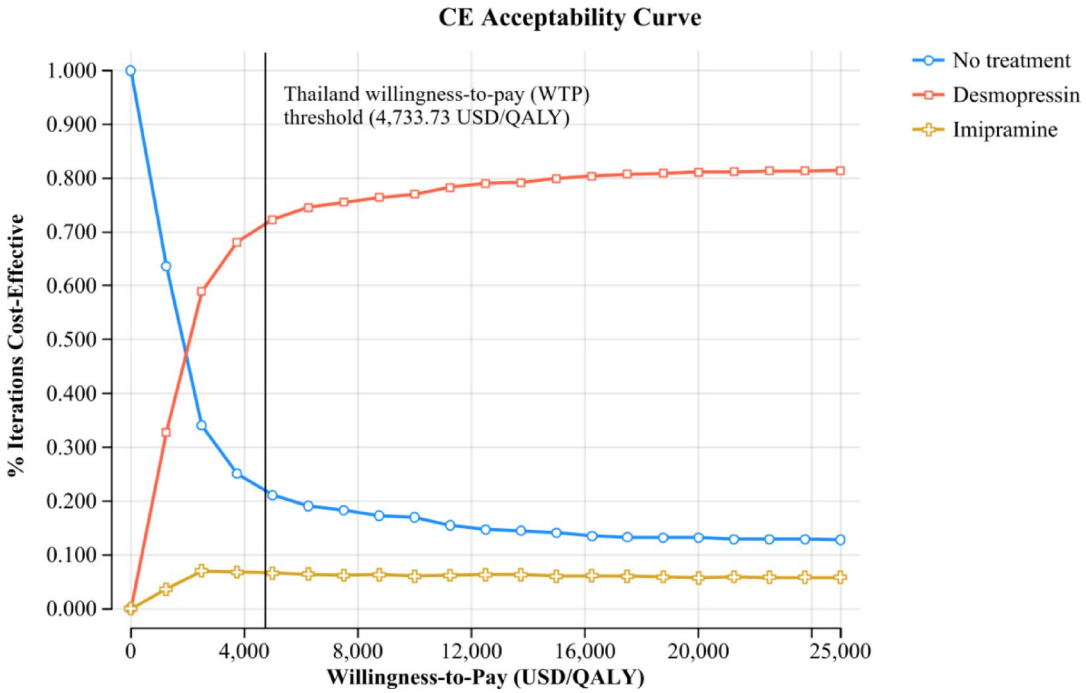

Fig. 4. Cost-effectiveness acceptability curve. The cost-effectiveness acceptability curve (CEAC) illustrates the probability of each treatment strategy being the most cost-effective option across a range of willingness-to-pay (WTP) thresholds (x-axis). The y-axis represents the percentage of simulations in which an intervention was cost-effective. At the Thai WTP threshold of $4,733.73/QALY, desmopressin has the highest probability of being cost-effective at approximately 74%. This probability remains stable and highest among the three options as the WTP threshold increases.

Treatment Options	Budget (million USD)					
	Year 1	Year 2	Year 3	Year 4	Year 5	Total
No Treatment	0.049	0.137	0.220	0.272	0.296	0.973
Imipramine	0.251	0.516	0.583	0.497	0.391	2.237
Desmopressin Acetate	2.980	6.602	7.656	6.076	3.684	26.998

Table 3. Budget impact analysis results. This table shows the estimated five-year budget impact from a payer perspective for the three management strategies for monosymptomatic nocturnal enuresis in Thailand. All financial projections are presented in millions of U.S. dollars (million USD). The analysis assumes a gradual market uptake for the new intervention, starting from 20% in Year 1 and increasing linearly to 100% by Year 5.

Scenario	Five-year budget impact (USD million)	Change from base case (%)
Base case	26.998	–
Slow uptake	21.914	− 18.83
Fast uptake	27.599	2.22
Drug price (− 20%)	22.343	− 17.24
Drug price (+ 20%)	31.653	17.24
Prevalence (8.5%)	24.045	− 10.94
Prevalence (11.1%)	30.402	12.61
Treatment duration (6 months)	50.272	86.21

Table 4. Five-year budget impact for Desmopressin acetate: base-case and scenario analyses. This table presents the estimated five-year budget impact of adopting desmopressin acetate for managing monosymptomatic nocturnal enuresis in Thailand, evaluated under the base-case and multiple scenario analyses. Results are shown in millions of U.S. dollars (USD). Each scenario varies a key model parameter—uptake rate, drug price, prevalence, or treatment duration—to assess the sensitivity of the total budget impact. The percentage change from the base case is provided to illustrate the relative magnitude of variation across scenarios.

Data availability

All data generated or analysed during this study are included in this published article. The parameters used for the model are listed in Table 1 of the manuscript, along with full citations for each data source.

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Author contributions
N.K.: Conceptualization, Methodology, Formal analysis, Investigation, Visualization, Writing—Original Draft. P.P.: Methodology, Data Curation, Writing—Review & Editing. P.L.: Methodology, Data Curation, Review & Editing. P.K.: Validation, Resources, Review & Editing. S.T.: Conceptualization, Supervision, Project administration, Funding acquisition, Writing—Review & Editing.

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Declarations

Competing interests
The authors declare no competing interests.

Ethical approval
This study was approved by the Institutional Review Board of the Faculty of Medicine, Chulalongkorn University, Bangkok, Thailand (IRB No. 0386/66). Informed consent was obtained from all healthcare professionals who participated in the interviews. No patient or caregiver data were collected in this study.

Additional information

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