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PERSPECTIVES

Supporting Medication Adherence and Patient-Centered Care for Attention-Deficit Hyperactivity Disorder in Taiwan: A Pharmacist-Oriented Perspective Informed by Targeted Evidence

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Abstract: Despite the broad coverage offered by Taiwan's National Health Insurance system, attention-deficit/hyperactivity disorder (ADHD) care continues to face a critical "leaky pipeline" problem. There is a clear gap between diagnostic prevalence and long-term treatment retention. This perspective article applies the SPIDER (Sample, Phenomenon of Interest, Design, Evaluation, Research type) framework to synthesize evidence on the multidimensional factors that contribute to medication non-adherence among Taiwanese children and adolescents. The barriers are grouped into five domains. These domains include medication-related issues such as dosing complexity, child-level developmental challenges related to growing autonomy, family dynamics that reveal a distinctive "socio-economic status paradox", stigma within school environments, and vulnerabilities at the healthcare system level. Together, these factors demonstrate that existing hospital-centered care models alone may not sufficient to support sustained treatment engagement. To address this gap, we propose a pharmacist-driven precision approach to improving adherence in ADHD. This approach redefines the pharmacist's role and emphasizes proactive involvement in ADHD management rather than passive medication dispensing. The proposed approach includes regimen optimization, digital tools that support adolescent self-management, and shared decision-making strategies that respond to family-specific concerns. Because community pharmacists are highly accessible, they can serve as continuity anchors across care settings and developmental stages and help strengthen treatment persistence and therapeutic outcomes.

Keywords: attention-deficit hyperactivity disorder, intervention, medication adherence, pharmacist, shared decision-making

Introduction

Attention-deficit hyperactivity disorder (ADHD) is a common neurodevelopmental condition affecting children and adolescents worldwide, with prevalence estimates ranging from 3.4% to 14.0%.[1–4] Pharmacotherapy is widely recognized as a cornerstone in ADHD management. Major clinical guidelines, including those from the American Academy of Pediatrics and the National Institute for Health and Care Excellence, recommend medication as a first-line treatment for school-aged children to prevent long-term complications.[5,6] Despite its demonstrated benefits, achieving consistent medication use remains a global challenge. Studies indicate that non-adherence to ADHD medications can range from 4.8% to 77% internationally.[7,8]

In Taiwan, gaps in ADHD care occur across the entire treatment continuum, from diagnosis to medication initiation and long-term continuation. Although the National Health Insurance provides broad access to care, community-based studies estimate the prevalence of ADHD at approximately 7.5%.[9] In contrast, real-world clinical data indicate a much lower diagnosis rate of 1.62% to 2.44%, pointing to substantial under-diagnosis.[10] Even among diagnosed youths, the use

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of ADHD medication is far from optimal. Wang et al found that 40–50% of children with a confirmed diagnosis never receive pharmacotherapy,[10] a pattern echoed by Huang et al, who reported a 39.2% non-initiation rate.[11] For those who do begin therapy, sustaining therapy is an even greater challenge. Discontinuation is frequent and occurs early. Chen et al reported that 93.2% of patients stopped medication within 1 year.[12] Although long-acting methylphenidate has become widely used, recent data indicate that only 19.9% of patients continue therapy for 12 months or longer.[11]

This "leaky pipeline" of ADHD treatment has serious clinical implications. Nationwide cohort studies in Taiwan show that individuals with ADHD are at increased risks of mortality[13] and traumatic brain injury,[14] both of which are markedly reduced by consistent medication adherence. Beyond these severe but relatively rare outcomes, poor adherence is associated with impaired academic performance, reduced home functioning, diminished quality of life, and increased caregiver burden and family stress.[15] In addition, it is linked to higher risks of adverse social outcomes, including criminality.[16,17] These more common consequences highlight the importance of promoting treatment initiation and persistence in pediatric ADHD.

Pharmacists are well positioned to improve ADHD medication adherence due to their accessibility, medication expertise, and frequent contact with patients and caregivers.[18] Theoretical frameworks, such as the Theory of Planned Behavior (TPB) and the Unified Theory of Behavior Change (UTBC), offer guidance for intervention design to improve medication adherence.[19] The TPB emphasizes the influence of attitudes, subjective norms, and perceived behavioral control on medication-taking intentions,[20] while the UTBC suggests the roles of knowledge and skills in enhancing willingness and persistence.[21] Pharmacists can leverage these frameworks by educating patients and caregivers, addressing beliefs about medication, and providing practical strategies, such as reminders or pill organization, thereby supporting both initiation and sustained therapy.[22] Given their underutilization in ADHD care in Taiwan, pharmacists could play a pivotal role in improving medication adherence.

Methods

This article presents a perspective informed by a targeted synthesis of Taiwan-based empirical evidence rather than a formal systematic review. The SPIDER (Sample, Phenomenon of Interest, Design, Evaluation, Research type) framework was used as a conceptual guide to structure the research question and eligibility criteria (Appendix 1).[23] The objective was to identify context-specific determinants of ADHD medication adherence relevant to service design.

A PubMed was conducted using Boolean operators ("OR" and "AND") to combine relevant keywords. Sample terms included "attention deficit disorder with hyperactivity", "ADHD", "child", "adolescent", "youth", "parent", "caregiver", "family", "Taiwan", and "Taiwanese". Phenomenon-of-Interest terms encompassed "medication adherence", "compliance", "persistence", "drug taking", "treatment initiation", "treatment delay", "discontinuation", and "continuation". Design-related terms comprised "observational", "cohort", "database study", "cross-sectional", "survey", and "questionnaire", while evaluation-related terms contained "factor", "determinant", "predictor", "barrier", "attitude", "belief", "stigma", and "family support" (Appendix 2).

Eligible studies were those that (1) involved children or adolescents diagnosed with ADHD in Taiwan, (2) investigated outcomes related to medication adherence, treatment initiation, or discontinuation, and (3) used quantitative (eg, nationwide database and hospital-based surveys), qualitative, or mixed-methods designs. Review articles, studies not focused on Taiwan, or studies unrelated to medication adherence were excluded. The purpose of this synthesis was to identify recurring determinant domains to inform a conceptual service framework, rather than to generate an exhaustive or fully reproducible evidence map.

Results

The initial search yielded 48 records. Following title and abstract screening, 40 records were excluded due to irrelevant topics (n = 38), review article (n = 1), or lack a Taiwan-specific focus (n = 1). Eight full-text articles were subsequently retrieved and assessed for eligibility. Three were excluded for not addressing medication (n = 2) or adherence-related factors. Ultimately, five studies were included in the final synthesis (Appendix 3).[11,12,24–26] Most studies relied on the National Health Insurance Research Database or hospital-based samples. Determinants of adherence identified in nationwide longitudinal studies were grouped into five domains: medication-related, child-related, family-related, school and environmental, and system-level factors (Table 1).

Table 1 Summary of Key Evidence on Factors Influencing Attention-Deficit Hyperactivity Disorder Medication Adherence and Related Interventions in Taiwan

Study (Author, Year)	Study Design & Data Source	Sample Size	Participants Age (Years)	Medication/ Intervention	Definition of Adherence/ Persistence	Key Findings (Influencing Factors & Outcomes)
Gau et al, 2006[24]	Cross-sectional; clinical interview at 2 medical centers	n = 307	Range: 6–17 (mean: 10.7)	Immediate-release methylphenidate (dosing: QD, BID, TID, QID)	Poor adherence: maternal report of the child missing more than 14 daily doses over the past month	• Dosing: three-times-daily dosing was associated with a higher likelihood of poor adherence (OR = 2.58, 95% CI: 1.10–6.08, $p < 0.05$) • Age: increasing age was associated with poorer adherence (OR = 1.24, 95% CI: 1.10–1.39, $p < 0.001$). • Family: poor adherence was associated with greater maternal distress ($p < 0.001$) and lower levels of family support ($p < 0.01$)
Gau et al, 2008[25]	Prospective intervention; national survey at 12 hospitals	n = 607	Range: 5–16 (mean: 9.5)	Phase 1: immediate-release methylphenidate Phase 2: switched to OROS methylphenidate	Poor adherence: missing >1 dose/day on >2 school days per week	• Switching: Switching to OROS was associated with improved adherence and enhanced parent-child interaction ($p < 0.001$) • Family history: a positive family history of ADHD was associated with poorer adherence (OR = 2.01, 95% CI: 1.18–3.41, $p = 0.01$) • Education: higher paternal education was associated with poorer adherence (OR = 1.72, 95% CI: 1.24–2.39, $p = 0.001$)
Chen et al, 2011[12]	Retrospective longitudinal; National Health Insurance Research Database	n = 10,153	18 years or younger	Immediate-release methylphenidate	Initiation: receipt of the first prescript Discontinuation: a gap of more than 90 days without a prescription refill	• Initiation: adolescents (12–17 years) had the highest rate of treatment initiation (aHR = 7.55, 95% CI: 6.21–9.18. • Discontinuation: adolescents also had a higher risk of early treatment discontinuation (aHR = 1.15, 95% CI: 1.02–1.30) • System: changing treatment location (eg, seeking a second opinion) was associated with a 58% lower risk of discontinuation (aHR = 0.42, 95% CI: 0.34–0.52)
Lien et al, 2015[26]	Retrospective longitudinal; National Health Insurance Research Database	n = 3583	Range: 3–5 (preschoolers)	Methylphenidate (compared with psychosocial, rehabilitation, or combined therapy)	Termination: a gap of more than 90 days without treatment	• Treatment mode: rehabilitation-only treatment had the lowest termination rate (Log rank test, $p < 0.001$) • Vulnerability: children from low-income families (aHR = 1.72, 95% CI: 1.09–2.70) or rural areas (aHR = 1.40, 95% CI: 1.06–1.85) faced higher risks of treatment termination • Provider: care from psychiatrists was associated with higher termination of psychosocial treatment (aHR = 1.80, 95% CI: 1.46–2.22)
Huang et al, 2021[11]	Retrospective longitudinal; National Health Insurance Research Database	n = 188,061	Aged 18 years or below	Immediate-release methylphenidate; OROS-methylphenidate; atomoxetine	Delayed initiation: more than 365 days elapsing from the date of ADHD diagnosis to the start of medication continuation of ADHD medications: cumulative defined daily doses used from the date of ADHD diagnosis.	• Socioeconomic paradox: high family income predicted delayed treatment initiation (OR = 1.52, 95% CI: 1.37–1.69) but better long-term continuation (OR = 1.34, 95% CI: 1.15–1.56). • Urbanization: adherence showed a U-shaped relationship, with the lowest adherence observed in suburban regions (OR = 0.79, 95% CI: 0.65–0.97) compared with urban centers

Abbreviations: ADHD, attention-deficit hyperactivity disorder; aHR, adjusted hazard ratio; BID, twice daily; CGI-S, Clinical Global Impression - Severity scale; CI, confidence interval; OR, odds ratio; OROS, osmotic-controlled release oral delivery system; QD, once daily; QID, four times daily; TID, three times daily.

Medication-related factors emerged as particularly influential. Complex dosing regimens, particularly three-times-daily schedules, were strongly associated with poor adherence (OR = 2.58, 95% CI: 1.10–6.08, $p < 0.05$) compared with once-daily dosing.[24] Although long-acting formulations improve convenience, side effects such as appetite loss remain common, affecting approximately 21% of users.[25] Additional barriers include unpleasant taste of certain medications and aversion to immediate-release formulations.[24,25]

Child-related factors also contribute substantially. Developmental stages play a central role, with adolescence (ages 12–17) associated with higher discontinuation risks (aHR = 1.15, 95% CI: 1.02–1.30), despite relatively higher initiation rates.[12] Issues of autonomy, such as refusal to take medication (12.7%) and forgetfulness (72.9%), were common challenges.[24] Behavioral and clinical characteristics can further influence adherence. Children with oppositional symptoms[25] or behavior problems at home[24] are more prone to discontinuation. In contrast, some comorbidities may facilitate adherence. For example, children with intellectual disability demonstrated better adherence (OR = 0.32, 95% CI: 0.16–0.60, $p < 0.001$), likely reflecting increased parental supervision.[25] Among adolescents, autism spectrum disorder was associated with longer treatment continuation, whereas anxiety disorders predicted earlier discontinuation.[11] This divergence likely occurs because stimulants can exacerbate somatic anxiety symptoms (eg, palpitations), leading to discontinuation, while the behavioral complexity of autism often necessitates sustained pharmacotherapy for symptom stability.

Family-related determinants present a complex and sometimes counterintuitive pattern. Huang et al reported a "socioeconomic status paradox" where higher household income (OR = 1.52, 95% CI: 1.37–1.69) was associated with treatment initiation delays exceeding 1 year.[11] This phenomenon likely reflects a "hesitancy gap", in which resource-rich families prefer to explore non-pharmacological options first or engage in prolonged deliberation about medication safety. Parenting-related factors, including maternal psychological distress, indifferent or overprotective parenting styles, family history of ADHD, and higher paternal education, have also been linked to poor adherence outcomes.[24,25] In particular, maternal distress may impair caregivers' capacity to maintain consistent supervision and routine enforcement of medication use.[24] Similarly, the association with higher paternal education may result from greater skepticism about medication necessity or a stronger preference for behavioral interventions among highly educated parents.[24,25] Parental beliefs additionally shape treatment decision-making. Common cited reasons for medication discontinuation include fear of side effects, a perceived lack of need for medication, the belief that the child's symptoms have improved, and judgments that the medication has "no effect".[24,26]

School and environmental factors further complicate medication adherence. Stigma associated with taking medication at school, embarrassment, and a lack of supervision for midday doses as frequently reported barriers.[24,25] Even teacher objection has been cited as an impediment to consistent treatment, possibly due to a lack of understanding regarding ADHD pharmacotherapy or a cultural preference for behavioral interventions in educational settings.[24] Geographic variation is also evident. Chen et al found that children in southern Taiwan initiated treatment earlier,[12] while Huang et al reported a U-shaped pattern between urbanization level and treatment continuation, indicating that adherence is consistently higher in both highly urbanized centers (due to resource accessibility) and rural areas (potentially due to stronger community-provider ties), while falling lowest in suburban regions (OR = 0.79, 95% CI: 0.65–0.97 compared to highly urbanized areas).[11]

Finally, system-level and healthcare-related factors exert substantial influence on treatment retention. Children from structural vulnerable backgrounds, such as those experiencing poverty (aHR = 1.72, 95% CI: 1.09–2.70) or living in rural areas (aHR = 1.40, 95% CI: 1.06–1.85), face higher risks of treatment termination.[26] Discontinuation rates are higher in regional (aHR = 1.27, 95% CI: 1.15–1.40) and district hospitals (aHR = 1.32, 95% CI: 1.17–1.49),[12] likely reflecting the disparity in specialized mental health resources and titration support compared to medical centers. Notably, switching treatment locations (seeking a second opinion) was associated with a 58% reduction in discontinuation risk (aHR = 0.42, 95% CI: 0.34–0.52).[12] This finding does not necessarily indicate fragmented care. Instead, it may reflect proactive care-seeking by families trying to find a provider who better fits their needs. This suggests the importance of provider–family alignment and renewed engagement in treatment. Treatment modality further affects retention, with rehabilitation-only care associated with lower termination rates. This pattern may reflect parental preferences for non-pharmacological

interventions perceived as safer or more "natural", as well as concerns about medication side effects and diagnostic labeling, which can contribute to delayed treatment initiation.[26]

Discussion

Despite these well-documented challenges, the role of pharmacists in ADHD management in Taiwan remains largely undefined and primarily limited to dispensing. Although continuity of care is essential, there is a notable absence of research describing proactive pharmacist involvement in addressing these multifaceted adherence barriers. This underscores the need for pharmacists to move beyond product-focused roles and toward managing these interacting determinants through a precision and patient-centered intervention model (Figure 1).

Optimizing Medication Regimens: Simplify and Monitor

As discussed earlier, structural characteristics of ADHD medication regimen, particularly multiple daily dosing and formulation intolerance, are key drivers of non-adherence. Even with the introduction of long-acting formulations, adverse effects such as appetite loss continue to contribute to early discontinuation. This finding aligns with global meta-analyses indicating that adverse effects are a universal barrier to stimulant adherence.[27] Pharmacists can address these barriers by proactively identifying patients on complex regimens (eg, more than once daily) and recommending a switch to once-daily formulations (eg, osmotic-controlled release oral delivery system), thereby reducing both logistical and taste-related adherence challenges.[28] In addition, active monitoring of side effect is also crucial, and pharmacists can incorporate standardized symptom checklists (eg, side effect domain of the Swanson, Nolan, and Pelham, Version IV scale) into routine refill encounters to track appetite changes or sleep disturbances and offer practical strategies, such as advising dose administration after a high-calorie meal, suggesting evening snacks, or counseling on sleep hygiene and, if appropriate, discussing adjunctive melatonin.[29]

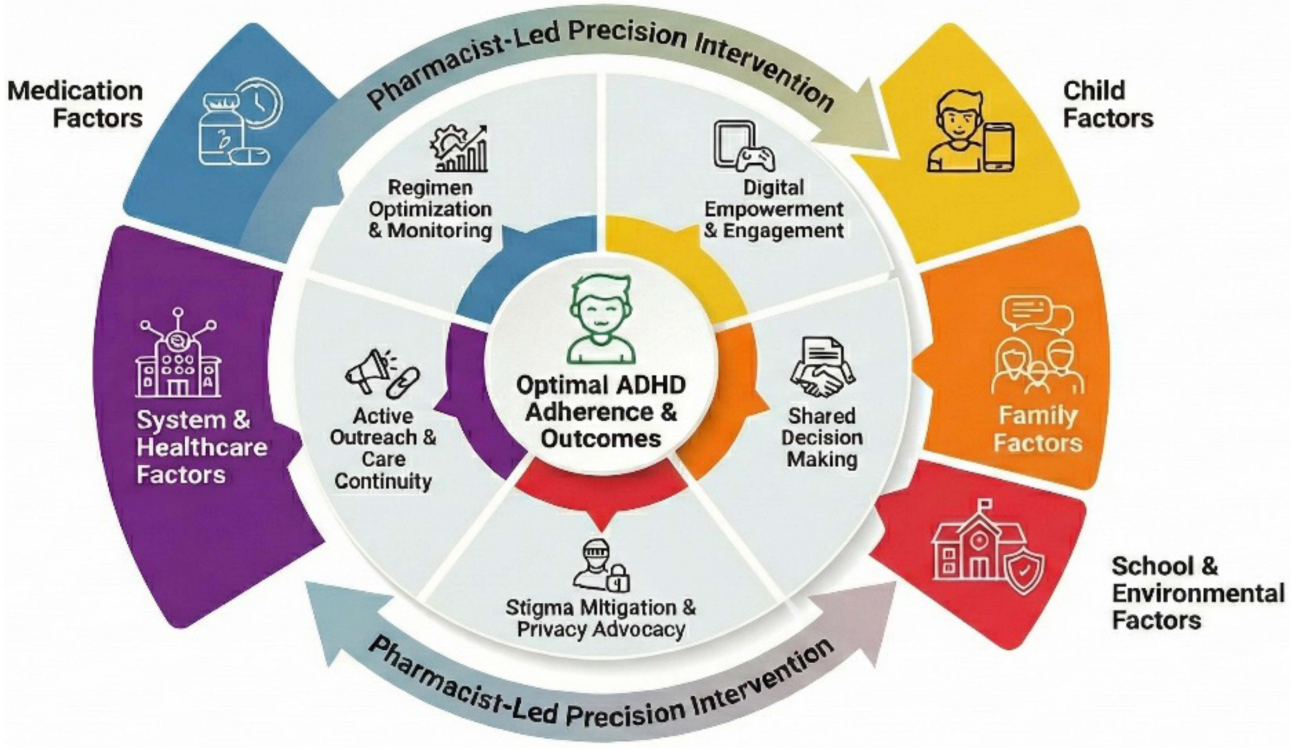

Figure 1 A Pharmacist-driven precision approach to enhancing adherence in attention-deficit/hyperactivity disorder. This conceptual framework illustrates how pharmacists can address multidimensional barriers across five key domains, including medication, child, family, school and environmental, and system and healthcare factors. By implementing targeted strategies such as regimen optimization, digital empowerment, shared decision-making, and active outreach, pharmacists can bridge the care gap and improve treatment outcomes.

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Empowering Children: Fostering Autonomy and Engagement

Adherence is strongly influenced by developmental stage. Adolescent represents a critical period during which the desire for autonomy often conflicts with sustained medication use, despite high initiation rates.[12] Common barriers include child refusal, forgetfulness,[24] and the impact of comorbidities, such as intellectual disability or anxiety.[11,25] Pharmacists can shift from an adherence-focused model to an empowerment-based approach by leveraging digital tools, such as reminder apps, gamified adherence trackers, and privacy-preserving platforms. These tools allow adolescents to actively manage their own medication schedules and in turn improve engagement and adherence.[19,30,31] Autonomy-supportive counseling further transforms medication-taking from a parental mandate to a personal responsibility, respecting their developmental need for adolescents while supporting therapeutic goals.[32]

Supporting Families: Reducing Hesitancy and Daily Burden

Family dynamics introduce a complex set of challenges in ADHD medication use, with both high-resource and structurally vulnerable families facing distinct barriers. The "socioeconomic status paradox", where higher-income families delay treatment initiation, points to a hesitancy gap often rooted in decisional conflict and exposure to conflicting information about medication labeling or safety.[33] As described by Ahmed et al, many parents enter a prolonged period of deliberation, carefully weighing perceived risks against potential academic benefits.[34] Conversely, families dealing with maternal distress, indifferent parenting styles, or a family history of ADHD often struggle with the daily routines required for supporting consistent dosing.[24,25] Another common contributor to missed doses or discontinuation is the perception that the medication has "no effect", which typically reflects misunderstandings about the gradual titration process rather than true pharmacologic failure, a pattern also observed internationally.[35]

Pharmacists can help resolve these barriers by adopting a targeted and supportive approach. Incorporating shared decision-making helps reduce hesitancy among high-resource families. Evidence shows that simple decision aids (eg, issue cards) improve parental understanding and lower decisional conflict,[36] while also ensuring that treatment choices align with family values and preferences.[37] For families experiencing substantial stress or when a parent may have ADHD-related symptoms, pharmacists can serve as organizational supports by offering practical tools, such as pill organizers or reminder systems and by delivering instructions that are concise, structured, and visually oriented. Finally, clear expectation-setting is essential. Explaining the titration timeline and emphasizing that clinical benefits may not immediately appear can correct misconceptions and prevent early discontinuation.

Navigating School and Environmental Barriers: Protect Privacy and Reduce Stigma

School and environmental contexts frequently create practical and social barriers to adherence. Embarrassment related to public dosing and missed doses at school are common.[24,25] Geographic disparities, urbanization-related differences in treatment continuation, further complicate adherence.[11] Pharmacists can address these barriers by advocating by recommending privacy-preserving regimens, such as once-daily doses taken at home and ensuring that treatment remains confidential, reducing dependence on school staff or teachers while mitigating stigma.[25,38]

Bridging System-Level Gaps: Community-Based Continuity

Structural vulnerabilities, including poverty and rural residence, are associated with higher risks of treatment termination.[26] The hospital-centric care model shows limitations, with higher discontinuation rates observed in regional hospitals, whereas seeking a second opinion reduces this risk.[12] To overcome these systemic barriers, adherence management could shift toward the community. Pharmacists can promote multimodal care by encouraging combined rehabilitation and medication approaches, operating pharmacist-led clinics to enhance monitoring,[39] and leveraging the accessibility of community pharmacies for outreach and tele-pharmacy services.[40] By acting as a stable, consistent point of care, pharmacists ensure continuity of care, especially for families navigating provider transitions, which evidence shows improved adherence and patient outcomes.[41]

Implementation Considerations: Feasibility and System Incentives

Although the proposed pharmacist roles are conceptually aligned with identified adherence determinants, their implementation depends on supportive system-level conditions. In Taiwan, community pharmacies are highly accessible and increasingly engaged in chronic disease management; however, ADHD-focused services are not yet part of routine practice.[42] Expanding pharmacists' roles would require targeted training in pediatric mental health communication, workflow adjustments to accommodate time demands, and reimbursement or policy mechanisms that recognize cognitive and counseling services beyond dispensing. Without appropriate structural incentives and clear role delineation clarification, uptake may remain limited despite theoretical feasibility. Therefore, the framework presented here should be viewed as a service development hypothesis that requires alignment with professional scope, funding models, and interprofessional collaboration.

Limitations

This work has several limitations. First, no primary data were collected from pharmacists, patients, or families, and the proposed framework has not yet been implemented or empirically tested. Further evaluation should be conducted. Second, the evidence synthesis was targeted and context-specific rather than comprehensive; additional determinants reported outside biomedical databases may not have been captured. Third, most included studies were observational, and the reported associations should not be interpreted as causal. Finally, the proposed pharmacist-oriented model is grounded in the Taiwanese healthcare context and may not be directly transferable to systems with different pharmacy roles or care delivery structures.

Conclusion

In Taiwan, ADHD medication is readily accessible through National Health Insurance system, yet long-term adherence remains suboptimal due to complex regimens, adolescent autonomy, family dynamics, and school stigma. Pharmacists are well placed to address these gaps by optimizing regimens, addressing safety concerns, and empowering families and adolescents through shared decision-making. These functions extend naturally from pharmacists' existing responsibilities and may contribute to improved clinical outcomes as well as stronger provider–family relationships. By ensuring continuity of care within the community, pharmacists may reposition pharmacies as accessible, patient-centered care settings that support sustained success in ADHD treatment.

Data Sharing Statement

The study materials and detailed analyses are available from the corresponding author upon reasonable request.

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Disclosure

The authors declare no conflicts of interest in this work.

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