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Adapting diabetes education for neurodiverse patients: A COM-B framework analysis of type 1 diabetes and attention deficit hyperactivity disorder

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ABSTRACT

Objective: To highlight the unique challenges faced by individuals with co-occurring Type 1 Diabetes (T1D) and Attention Deficit Hyperactivity Disorder (ADHD), and to advocate for the adaptation of Therapeutic Patient Education (TPE) through tailored strategies and interdisciplinary care models.

Methods: Using the COM-B model (Capability, Opportunity, Motivation – Behavior) as an analytical framework, we explore how executive dysfunction in ADHD impacts diabetes self-management. Drawing on current literature, clinical insights, and behavioral theory, the article identifies barriers to effective care and proposes adaptations to TPE that better address cognitive and behavioral needs.

Results: Executive function deficits in ADHD impair psychological capability to perform essential diabetes management tasks, while limited access to mental health integration and inadequate caregiver involvement reduce environmental opportunity. Motivational challenges are compounded by repeated experiences of perceived “non-compliance.” Tailored education strategies, including simplified routines, technological supports, structured environments, and affirming communication can enhance engagement and outcomes. Interdisciplinary collaboration is critical to implementing these adaptations.

Conclusion: Current TPE models are not fully equipped to serve patients with both T1D and ADHD. Integrating cognitive screening, personalized education techniques, and cross-disciplinary expertise can close this gap. By embracing neurodiversity in chronic disease education, health systems can move toward more equitable and effective care for all.

1. Introduction

The management of Type 1 Diabetes (T1D) places a significant cognitive and emotional burden on individuals, who must engage in regular self-monitoring, insulin administration, carbohydrate counting, and daily decision-making [1]. These complex tasks rely heavily on executive functions including planning, attention regulation, working memory, and impulse control. For individuals with co-occurring Attention Deficit Hyperactivity Disorder (ADHD), these cognitive demands are magnified, and the ability to manage diabetes effectively is often compromised [2].

T1D affects approximately 9.15 million people worldwide, including 1.81 million children and adolescents [3], accounting for 5–10 % of all diagnosed diabetes cases [4] whereas ADHD, one of the most common neurodevelopmental disorders, affects about 5 % of the general population [5]. It is worth noting that, in women, subtler symptoms often delay diagnosis, though gender proportions tend to balance in adulthood [6].

T1D is usually diagnosed during childhood, when parents manage most self-care tasks. Adolescence, marked by the gradual transfer of these responsibilities to the young person, represents a particularly vulnerable stage. The coexistence of ADHD during this period inevitably amplifies these challenges.

Meta-analyses report a significant bidirectional association between

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T1D and ADHD: individuals with ADHD show a higher likelihood of developing T1D (OR = 1.37, 95 % CI 1.17–1.61), while individuals with T1D have an increased prevalence of ADHD (OR = 1.35, 95 % CI 1.08–1.73) [2].

ADHD is a neurodevelopmental condition characterized by persistent patterns of inattention, hyperactivity, and impulsivity. These symptoms can interfere with adherence to routine self-care behaviors, leading to missed insulin doses, inconsistent blood glucose monitoring, and increased risks of both acute and long-term diabetes-related complications. Evidence indicates that individuals with both T1D and ADHD experience poorer glycemic control, more frequent episodes of diabetic ketoacidosis (DKA), and higher healthcare utilization rates [7]. Yet, despite the substantial implications of this dual diagnosis, it remains under-recognized and under-addressed in standard diabetes care.

Therapeutic Patient Education (TPE) serves as a cornerstone of chronic disease management, including for diabetes [8–10]. It empowers patients with the knowledge, skills, and confidence needed to engage in effective self-care, make informed decisions, and adapt to the daily challenges of living with a chronic condition. However, conventional TPE approaches often assume intact cognitive functioning and do not account for the executive challenges associated with ADHD. As a result, patients with co-occurring ADHD may struggle to benefit from education programs that are not designed with their needs in mind.

This review explores the specific challenges faced by individuals living with both T1D and ADHD, with the aim of identifying implications for TPE.

2. Methods

This article is based on a narrative literature review designed to explore how executive function impairments associated with ADHD influence self-management in individuals with T1D, and how TPE strategies can be adapted to address these challenges. A narrative review approach was chosen rather than a scoping or systematic review because the objective was to synthesize and interpret findings across disciplines (psychology, diabetes care, and behavioral medicine) to generate conceptual insights rather than to exhaustively map all available evidence [11–13].

The guiding research question was: *How can integrating ADHD-related executive dysfunction into TPE improve diabetes self-management in adolescents and adults with T1D?*

The literature search was conducted between 2020 and 2024 across four databases: PubMed, Embase, CINAHL, and the Cochrane Library. The search strategy used MeSH terms and keywords including “ADHD”, “Type 1 Diabetes”, “Executive Functions”, “Therapeutic Education”. As an example, the detailed search strategy used for PubMed is provided in Appendix 1.

Inclusion criteria focused on studies examining the co-occurrence of ADHD and T1D, or ADHD-related interventions transferable to diabetes care in adolescents and adults. Excluded were studies on type 2 diabetes, animal or genetic studies, prevalence-only data, non-autonomous populations (e.g., children or elderly), and non-peer-reviewed formats (e.g., letters).

We use the COM-B model (Capability, Opportunity, Motivation—Behavior) as a guiding framework to analyze the challenges individuals with co-occurring T1D and ADHD face in engaging with self-care behaviors [14]. The COM-B model, developed as part of the Behavior Change Wheel, provides a structured approach to understanding how individual capabilities, contextual opportunities, and motivational processes interact to influence health-related behavior [14].

We apply this model to examine how executive dysfunction associated with ADHD, affecting planning, working memory, attention regulation, and impulse control may impair patients’ psychological capability to perform diabetes self-management tasks. In parallel, we explore how social and environmental opportunities, as well as intrinsic and extrinsic motivational factors, influence adherence to therapeutic regimens.

This conceptual lens also informs our analysis of how TPE can be adapted to accommodate cognitive barriers and promote more equitable health outcomes. Drawing on literature from diabetes care, neuropsychology, and behavioral science, we identify key modifications to existing education strategies and advocate for interdisciplinary models that address the full spectrum of factors influencing behavior. Our goal is to bridge theory and practice by proposing actionable recommendations for health professionals involved in TPE delivery.

3. Results

A total of 2114 articles were identified. After removal of duplicates and screening by title and abstract, 43 full-text articles were reviewed including five additional clinically relevant papers. Three key articles were selected for in-depth analysis based on conceptual relevance to the dual diagnosis and their contribution to behavior-focused educational interventions [15–17].

The selected studies highlight how ADHD-related cognitive, environmental, and emotional factors interfere with diabetes self-management. We present the main findings organized according to the COM-B framework:

3.1. Capability: Addressing executive dysfunction

Effective self-management of T1D requires robust executive functioning—skills such as planning, attention regulation, inhibitory control, and working memory. Across multiple studies, these cognitive processes were shown to be compromised in individuals with ADHD, resulting in reduced adherence to diabetes management routines.

Duke et al. [1] introduced the Diabetes-Related Executive Functioning Scale (DREFS) to measure how ADHD-related impairments in attention, organization, and memory directly affect diabetes-specific tasks [15]. These include insulin dosing, carbohydrate tracking, and timely glucose monitoring. Wasserman et al. [16,17] emphasized that diabetes care is 99 % self-managed, making executive functioning a critical determinant of metabolic outcomes. Patients with executive dysfunction were shown to be more likely to miss insulin doses, apply incorrect corrections, or skip routine measurements, contributing to glycemic instability.

These cognitive barriers are not reflective of a lack of knowledge or motivation but stem from intrinsic neurodevelopmental constraints.

To enhance capability, TPE must move beyond information delivery and incorporate cognitive-supportive teaching methods. Education should be broken down into small, digestible components that reduce mental overload. Visual aids, flowcharts, and illustrated checklists can help clarify processes and improve retention. For instance, a visual insulin dosing guide may serve better than a verbal explanation alone. Written step-by-step routines tailored to the individual’s daily context can offer structure and predictability.

Technology can also serve as a compensatory tool. Smartphone applications, glucose meters with alarms, or connected insulin pens with reminders can support memory and help patients adhere to complex regimens. By externalizing demands on working memory and supporting attention regulation, these tools function as extensions of the individual’s cognitive system.

3.2. Opportunity: Creating supportive environments

Capability alone is insufficient when opportunities to engage in care are lacking. Many patients with both ADHD and T1D face systemic barriers, such as fragmented healthcare systems where mental health and diabetes care are siloed, or lack of access to providers trained in neurodiversity. There is currently no standardized cognitive screening protocol integrated into routine diabetes care. Although tools like the

DREFS provide promising insight, they remain underutilized, especially in non-English-speaking contexts [15]. Time constraints, lack of provider training, and institutional silos were repeatedly cited as barriers to recognizing and addressing executive dysfunction in clinical settings [16,17].

Social and familial contexts also influence opportunity. While parental support can reinforce adherence in adolescents, its protective effect may be reduced when ADHD is present in the family system. Wasserman et al. [17] noted the strong heritable nature of ADHD, which can affect parents' own executive functioning, complicating their ability to provide consistent support.To improve opportunity, TPE should be delivered as part of a broader interdisciplinary care model. Integrating diabetes educators, pediatric or adult endocrinologists, psychiatrists, and neuropsychologists enables comprehensive assessment and personalized planning. Routine screening for cognitive barriers, using tools such as the DREFS can help educators tailor content and pace to the individual's cognitive profile.

In addition, involving caregivers or family members—when appropriate—can provide essential scaffolding. Structured support at home may include shared responsibility for checking supplies, preparing for clinic visits, or setting up reminders together. Education sessions that include both patient and caregiver can improve communication and ensure that everyone is working from a shared understanding of expectations and strategies.

3.3. Motivation: Rethinking compliance through a neurodivergent lens

Motivation, as understood in the COM-B model, encompasses both deliberate intention (reflective motivation) and affective regulation (automatic motivation). In the context of T1D and ADHD, both dimensions are impacted.

Shaw et al. [18] demonstrated that emotional dysregulation is not peripheral but core to the ADHD phenotype. Patients experience excessive emotional reactivity, difficulty modulating affective intensity, and prolonged emotional recovery. These traits disrupt goal-directed behaviors and reduce the persistence required for effective self-management.

Wasserman et al. [17] and Duke et al. [15] further described how emotional dysregulation in adolescents can erode motivation by triggering cycles of avoidance, guilt, and failure. Patients with ADHD may experience repeated non-adherence, which is often misinterpreted as a lack of willpower rather than a manifestation of emotional and cognitive overload.

This feedback loop, where frustration leads to disengagement, worsening glycemic control, and increased emotional distress, was identified as a key barrier to consistent self-care. Motivation in these patients must therefore be supported through emotionally safe educational environments, reinforcement of small successes, and individualized goal-setting strategies.

To foster motivation, TPE must adopt a strengths-based, affirming approach. Positive reinforcement should be used to celebrate incremental achievements, such as checking blood glucose consistently for one week or successfully using an insulin reminder app. Recognizing and validating effort, rather than perfection, builds confidence and reduces shame-based disengagement.

Educators can also apply motivational interviewing techniques to explore the patient's values and goals, helping to establish intrinsic motivation aligned with what matters most to the individual. For example, a teenager may be more motivated to manage glucose effectively if framed in the context of being able to participate fully in sports or attend school trips without interruption. Providing safe space for emotional expression and supporting emotional regulation skills is also crucial, particularly in adolescents.

Ultimately, rethinking "compliance" through a neurodivergent lens allows healthcare professionals to move from judgment to partnership—focusing not on what patients are failing to do, but on how the system can better support their success.

3.4. Toward adaptive, inclusive education

The application of the COM-B model reveals that the traditional one-size-fits-all approach to diabetes education is not well-suited to patients with ADHD. These individuals require adaptations that span all dimensions of behavior change: enhancing their cognitive capacity to follow through with tasks, ensuring their environment supports rather than hinders self-management, and cultivating internal motivation without blame. To synthesize the proposed adaptations, Fig. 1 presents a visual model of how the COM-B framework can guide therapeutic education strategies for patients with co-occurring T1D and ADHD.

In this context, therapeutic education must be more than instructional—it must be empowering, flexible, and personalized. Health professionals must be trained to recognize cognitive diversity and adjust their strategies accordingly. Interdisciplinary collaboration is not optional but essential, ensuring that behavioral, psychological, and medical expertise converge in support of the patient.

4. Discussion and conclusion

4.1. Discussion

The intersection of T1D and ADHD presents a complex clinical landscape that is not yet adequately addressed in routine care. Through the lens of the COM-B model, this review has illustrated how executive dysfunction in ADHD can compromise diabetes self-management across all behavioral domains—capability, opportunity, and motivation. The co-occurrence of T1D and ADHD tends to create a vicious cycle in which each condition exacerbates the other, leading to poorer glycemic control, which in turn further impairs neuropsychological functioning, thereby promoting the emergence of diabetes-related complications and ultimately reducing the patient's quality of life with a significant impact on morbidity [19]. Despite these well-documented challenges, TPE programs have yet to systematically account for neurodevelopmental diversity, particularly executive function deficits that impair adherence to standard care protocols.

Traditional models of TPE, while effective for many, often rely on assumptions of stable attention, working memory, and planning capacity. These assumptions overlook the needs of patients with ADHD, who may possess the knowledge to manage their condition but lack the cognitive tools to act on that knowledge consistently. Without appropriate adaptation, these individuals are at risk of being labeled as "non-compliant" or "unmotivated," when in fact the root issue lies in a mismatch between educational delivery and cognitive profile.

This misalignment is not only clinically problematic but also ethically troubling. It risks further marginalizing patients who already face increased health risks and healthcare utilization. In contrast, adopting a neurodiversity-informed model of TPE promotes equity by recognizing and respecting cognitive differences. It also aligns with a growing emphasis in healthcare on person-centered and strengths-based approaches, particularly for populations with complex needs [20].

Interdisciplinary collaboration emerges as a key solution to this challenge. By integrating mental health professionals and neuropsychologists into diabetes care teams, clinicians can develop a more nuanced understanding of patients' cognitive functioning and tailor education accordingly [21]. Tools such as the DREFS scale offer a starting point for systematic screening, but their routine use in practice is still limited [15]. Implementation science efforts are needed to translate these tools from research to real-world care.

The potential benefits of such adaptation are far-reaching. Not only can tailored strategies improve glycemic control and reduce acute complications, but they may also enhance quality of life, decrease caregiver burden, and foster greater patient autonomy. These outcomes are particularly meaningful in adolescence and young adulthood, when

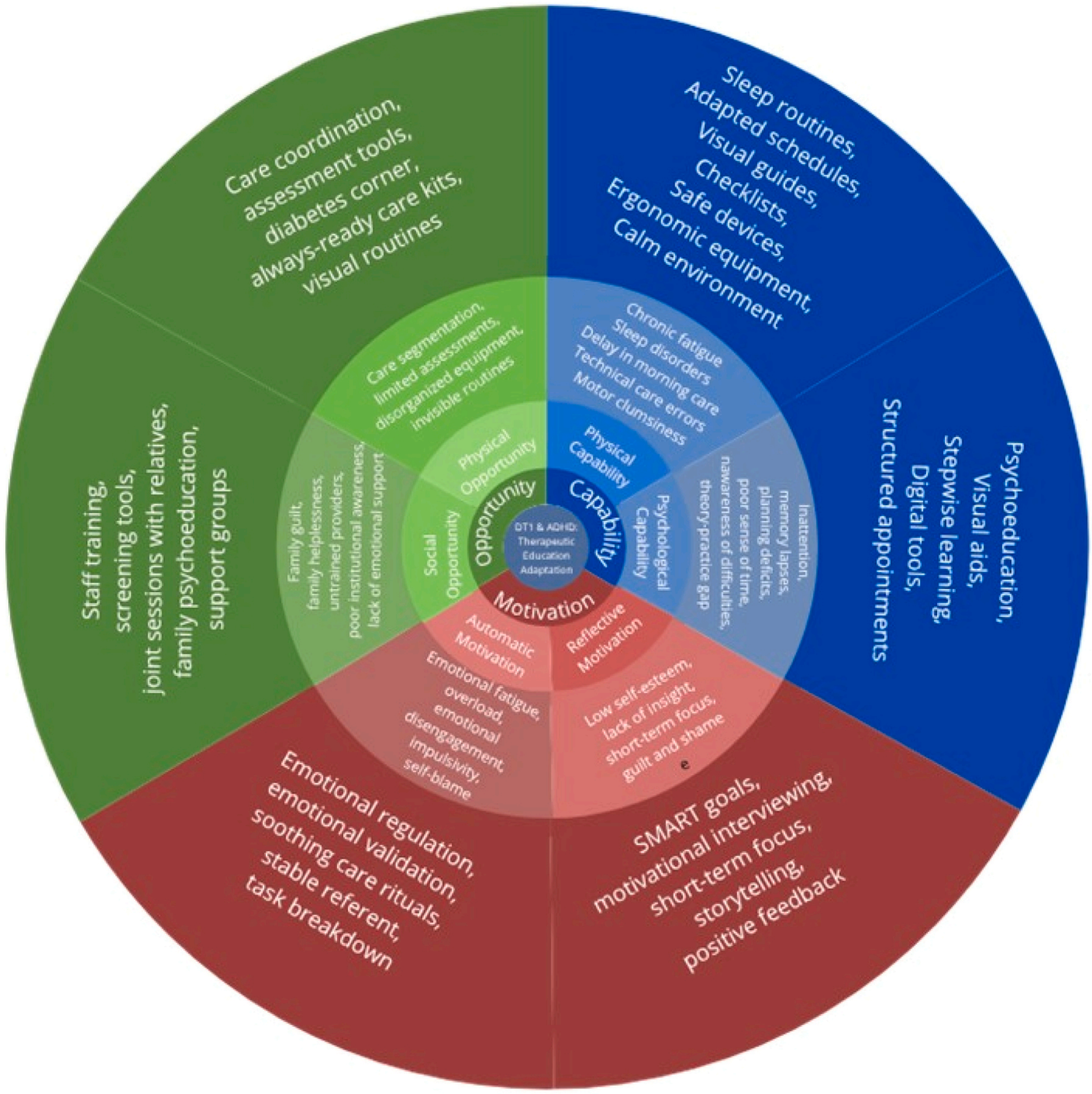

Fig. 1. COM-B Framework Adaptation for Type 1 Diabetes and ADHD: *A visual model illustrating how cognitive, environmental, and motivational barriers to diabetes self-management in patients with ADHD can be addressed through specific, tailored interventions. The outer ring proposes adaptation strategies for each COM-B domain: Capability (blue), Opportunity (green), and Motivation (red), integrating both patient-level and system-level solutions.*

both diabetes management and ADHD symptoms are at their most demanding [17].

Nonetheless, challenges remain. Health systems are not always structured to support interdisciplinary models, and healthcare providers may lack training in recognizing or responding to cognitive challenges. Furthermore, few guidelines exist to standardize care for patients with this dual diagnosis. These gaps underscore the need for clinical research, educational reform, and policy advocacy focused on this overlooked intersection. Table 1 summarizes key ADHD-related barriers to T1D management and corresponding TPE adaptations structured by the COM-B domains.

4.2. Conclusion

The co-occurrence of Type 1 Diabetes and Attention-Deficit/Hyperactivity Disorder presents a complex clinical reality that is often misunderstood or overlooked. Rather than attributing poor outcomes to non-adherence or lack of engagement, clinicians must be equipped to ask: *What cognitive barriers might this patient be facing, and how can I help them overcome them?*

The shift toward inclusive and interdisciplinary care is both necessary and achievable. It does not require sophisticated technology or entirely new systems, but rather the integration of what we already know: that patient behavior is shaped by a dynamic interplay of internal and external factors, and that education is most effective when it meets patients where they are.

We therefore call on healthcare providers, educators, and policymakers to act:

- **Clinicians** should incorporate routine cognitive screening into diabetes care pathways, using validated tools to identify patients who may require adapted strategies.
- **Educators** should be trained to recognize signs of executive dysfunction and adjust teaching methods to accommodate attention, memory, and planning challenges.
- **Health systems** must foster interdisciplinary collaboration between diabetes specialists, mental health professionals, and neuropsychologists to build comprehensive, person-centered care models.

Table 1
COM-B framework applied to type 1 diabetes and ADHD: educational barriers and adaptations. A synthesis of barriers to diabetes self-management among individuals with ADHD and corresponding adaptations to Therapeutic Patient Education (TPE), categorized according to the COM-B model: Capability, Opportunity, and Motivation.

COM-B domain	ADHD-related barriers	TPE adaptations
Capability	Impaired executive function (e.g., forgetfulness, distractibility, poor planning)	Simplify instructions; use visual aids and step-by-step routines; support with apps and reminders
Opportunity	Limited access to interdisciplinary care; lack of caregiver involvement or trained educators	Integrate care teams; involve family members; use screening tools like DREFS
Motivation	Reduced self-efficacy; history of perceived failure; emotional dysregulation	Use positive reinforcement; apply motivational interviewing; reframe adherence through a neurodiversity lens

- **Researchers** should prioritize the development and validation of practical, scalable tools and interventions that support individualized TPE for neurodiverse populations.

By embedding cognitive accessibility into the foundation of diabetes education, we can move toward a future in which no patient is left behind—not because of their condition, but because of how we choose to meet their needs.

4.3. Practice implications

- Routine screening for executive functioning and ADHD symptoms should be considered in adolescents and adults with T1D, particularly those with unexplained difficulties in adherence or self-management.
- Tools such as the DREFS can be integrated into clinical workflows to inform individualized education plans and guide follow-up.
- TPE programs must shift toward structured, simplified, and visually supported methods, including digital tools and external memory aids, to accommodate cognitive limitations.
- Interdisciplinary collaboration between diabetologists, mental health professionals, neuropsychologists, and educators is essential to bridge current gaps in care.
- Educators and providers should receive training on ADHD and executive functioning to better tailor their approach and avoid reinforcing negative feedback loops.
- Future research is needed to evaluate the impact of adapted education strategies and to validate practical tools across languages and healthcare settings.

CRediT authorship contribution statement

Nader Perroud: Writing – review & editing, Validation, Supervision. **Elise Chivoret:** Writing – review & editing, Writing – original draft, Formal analysis, Conceptualization. **Zoltan Pataky:** Writing – review & editing, Validation. **Jorge César Correia:** Writing – review & editing, Validation, Supervision, Methodology, Formal analysis, Conceptualization. **Karim Gariani:** Writing – review & editing, Validation, Supervision.

Declaration of Competing Interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: Pr Zoltan Pataky reports article publishing charges was provided by Swiss National Science Foundation. If there are other authors, they declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at doi:10.1016/j.pec.2025.109448.

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