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Practical Strategies to Enhance Executive Functioning and Strengthen Diabetes Management Across the Lifespan

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Abstract

The complex type 1 diabetes (T1D) management regimen places extra demands on one's ability to plan, organize, and problem-solve, a set of skills described as executive functioning (EF). Research on the relation between EF and T1D management has been mounting and suggest that deficits in EF skills likely interfere with optimal management. However, given the substantial EF demands of T1D management, any person with T1D, including those without clinically significant deficits, could likely benefit from strategies to improve diabetes-related EF skills. The current review outlines typical EF development across the lifespan and suggests behavioral strategies (e.g., environmental modifications) from the EF literature and clinical experience to enhance EF skills at each period of development. When executive dysfunction is suspected, formal neuropsychological assessment is recommended as EF concerns can be a significant problem of their own, or they could be an indicator of another psychological disorder, such as depression or dementia.

Keywords

Type 1 diabetes; Executive functioning; Lifespan development; Pediatric; Review

Introduction

Diabetes management places extra demands on one's ability to form goals, plan, and perform effectively, which are skills more broadly described as executive functioning (EF) [1]. The term EF originates from Baddeley's description of a "central executive system" in the brain [2], which was equated to a chief executive officer [3] whose job is to oversee the

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Compliance with Ethics Guidelines

Conflict of Interest Rachel M. Wasserman, Marisa E. Hilliard, David D. Schwartz, and Barbara J. Anderson declare that they have no conflict of interest.

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mission of the company, solicit feedback, and formulate/implement strategic plans. Advancements in brain imaging have negated the idea of a specific "central executive" area of the brain [4]; however, considerable research has illustrated typical development and application of these cognitive processes responsible for EF skills. Considering the numerous, detail-oriented tasks of type 1 diabetes (T1D) management, EF skills are certainly involved in ensuring diabetes management is completed correctly and in a timely manner.

Recent studies indicate a bidirectional relation between stronger EF skills and greater adherence ([5••] see Fig. 1). While the mechanism is unclear and effect sizes are generally small, studies have demonstrated that the diabetes disease process can adversely affect EF skills ([6••, 7–9] Fig. 1, link c). Poorer EF skills also have the potential to lead to difficulties with diabetes management ([5••, 10–13] Fig. 1, link a), which is known to worsen glycemic control ([14] see Fig. 1, link b). In light of these associations, researchers have recommended that diabetes care providers consider their patients' EF skill abilities in formulating care plans [5••, 6••]. However, few specific recommendations for interventions or environmental accommodations to support diabetes-related EF skills are available. In the following sections, we incorporate a review of neuropsychological literature with our clinical experience to provide a perspective on applications of EF skills with T1D management across the lifespan, and offer recommendations to support diabetes-related EF skills.

Key Components of EF

As EF has been studied by different disciplines (e.g., developmental, cognitive, and neuropsychology), there exist many theoretical models, with no agreement about the best or most inclusive model (for a review see [15•]). Still, there seems to be general agreement on several overarching ideas about EF. First, EF is a system of behavioral and cognitive control that serves *goal directed behavior*, which is related to but distinct from other cognitive functions (e.g., intelligence [16, 17]). EF skills interact in ways that potentially can help or hinder diabetes management. For example, impulse control (the ability to inhibit behavioral responses) allows a person to choose and plan how he/she will respond to facilitate reaching a goal [18]. This EF skill might allow a teenager to bolus insulin at the dinner table and wait a few minutes before eating the food in front of him/her. Working memory (the ability to hold information in one's mind and actively work with it in some way) [18] allows a person to solve novel problems by considering relevant information from previous experiences and current environmental stimuli. For instance, when deciding whether to bolus for a high blood glucose number before exercising, a person might consider whether he/she typically goes lower during exercise, the type and duration of planed exercise, what kind of food he/she last ate, etc. Working memory allows a person to consider all of these factors at once and decide on a planned response. Second, it is generally agreed EF is composed of several interrelated yet distinct processes [18, 19] that primarily involve the frontal lobes and their connections throughout the brain, as supported by clinical case studies, functional neuroimaging, and factor analytic studies [20, 21]. While EF does not occur in isolation, for the purposes of this review, we offer one model to guide the reader's understanding of how EF might apply to T1D management (see Table 1). Third, EF is *context dependent*, in that EF needs to be considered within the environmental contexts in which they operate. For example, one's ability to regulate attention will differ based on *internal* contexts (e.g., developmental stage [23–25]) and *external* contexts (e.g., family vs. school environment [26]). These overarching principles are used to guide discussion in the following sections about EF at different developmental periods, and practical suggestions for T1D management are provided based on the work of Dawson and Guare [27]; Guare, Dawson, and Guare [28•]; Barkley [29]; and others on supporting EF skills.

Preschool Years: Developing EF

EF Skills in Preschool

Basic EF skills emerge in the preschool years [23, 30•]. One aspect of EF skills that undergoes major development at this stage is impulse control, or the ability to inhibit natural or automatic responses such as touching items of interest or saying the first thing that comes to mind [31–33]. While gains in impulse control are apparent, they are not fully developed in these early ages, and preschool children struggle with controlling their impulses consistently across different environments [30•]. To exert impulse control, preschool children rely more on external control and structure provided by adults, than on internal executive control mechanisms [34]. Indeed, parental scaffolding that provides structure and support (e.g., reminding a child to stay seated) can enhance a young child's impulse control [35].

Implications of Preschool-Age EF Skills for Diabetes Management

Impulsivity poses a particular challenge for managing T1D in young children. Even if children show understanding of rules (e.g., you are not allowed to touch diabetes supplies), their immature impulse control may interfere with their ability to comply. Young children may quickly lose focus and try to disengage before a diabetes management task is completed or have difficulty waiting to eat after being given insulin. Poor inhibitory control can also result in the preschool child with T1D grabbing anything of interest, including syringes, insulin vials, and sweet treats. Also, preschoolers tend to have poorly developed understanding of the future, so they are unlikely to perceive the long-term benefits of completing diabetes-related tasks. This can make it difficult for parents to secure their cooperation for diabetes management, which has relative few immediate rewards. Taken together, preschool-age children are generally unable to engage in T1D tasks on their own and thus rely on their caregivers.

Recommendations to Support EF Skills and Diabetes Management in the Preschool-Age Years

To address impulsivity and prevent premature disengagement from diabetes tasks, an approach recommended by Dawson and Guare [27] may be helpful: make the task seem shorter. This can be accomplished by reducing the amount of work required (e.g., bring T1D supplies to child rather than having them stop their activity to come to the parent) or having the end in sight (e.g., set a kitchen timer for when the child will be able to eat after administering insulin). Distraction is another way to make a task seem shorter. Because preschool children have difficulty engaging in more than one activity at a time, distraction techniques can be especially effective at this age. For example, an interactive toy may help some children cooperate with injections and blood glucose monitoring. Due to the preschool child's limited understanding of the future, lengthy explanations of why they now need insulin and blood glucose checks are not as helpful as direct, simple explanations.

To explicitly teach and enhance EF skills, Dawson and Guare [33] recommend a three step approach. Before the task, parents should state what will happen and what the child is expected to do (e.g., “I am going to check your blood sugar, I need you to sit on this chair and wait until we see the number on this meter”). During the task, parents can coach the child on the desired behavior (e.g., “remember we need to wait for the number on the meter”). After the task, provide positive reinforcement (e.g., “great job holding still for your blood sugar check”).

There are also environmental changes that can be made to accommodate young children's impulsivity. To prevent preschoolers from grabbing syringes or lancets or pushing buttons on an insulin pump, parents are recommended to keep diabetes supplies out of sight and reach. Similarly, parents can use the “lock out” feature on an insulin pump or try a tubeless model. In order to help young children wait until after an insulin administration to eat a meal/snack, parents could give insulin away from the table, so as not to cue hunger signals.

Grade-School Years: Strengthening EF

EF Skills in Grade-School

By grade-school, impulsivity has drastically improved, as most children are better able to inhibit their initial responses. In addition, working memory undergoes a steady pattern of growth from preschool through adolescence [23, 36–38]. As these skills develop, children are better able to stop their initial response and think through/plan a more appropriate response. Perhaps as a reflection of their strengthening EF skills, children in this developmental stage are often given more responsibilities (e.g., homework, chores), and must learn to use their EF skills to manage these additional responsibilities. Still, these skills are just emerging and thus, may be less stable and more error-prone [30•].

Implications of School-Age EF Skills for Diabetes Management

As impulsivity improves, school-age children may be allowed more direct access to T1D supplies. Moreover, with improvements in working memory, some children may be increasingly able to keep track of their T1D supplies away from home (e.g., in desk or diabetes bag) and conduct some diabetes management tasks (e.g., checking blood glucose (BG)). School-age children may also become more active in planning a schedule, such as deciding when to check blood glucose and administer insulin during their morning routine. As attentional control continues to develop, children can more fluidly transition from one task to another, making it easier for them to take a brief break from activities to conduct T1D tasks. Still, children in this age range may not yet have the ability to stop what they are doing on their own to conduct diabetes care, and might require prompting from parents or other external cues (e.g., watch alarm). As EF skills are not fully developed, expectations for independence without adequate adult supervision will likely result in errors.

Recommendations to Support EF Skills and Diabetes Management in the School-Age Years

As EF skills increase and school-age children become more involved in their diabetes management, parents still need to provide support for developing EF skills and supervise all diabetes-related activities. Dawson and Guare recommend using a combination of behavioral modeling and direct, immediate feedback to most efficiently teach EF skills [33]. Prior to a task, an adult should demonstrate or rehearse the task with the child (e.g., “We're going to spend the next 10 min organizing your school diabetes kit. Let's make a list of the steps we have to go through to do this”). During the task, the adult should coach the child through the steps verbally. If errors occur, the adult should provide a gentle, directive prompt and take note of the barriers to successful task execution (e.g., distracted) to address later. Following task completion, the adult should praise the child's effort and all steps that were completed successfully, and provide clear guidance regarding any errors that occurred. Together with the child, a caregiver can set a goal and create a plan for next time. Over time, the adult's directive role can be faded as the child completes the tasks successfully, although reminders to begin each task and monitoring should continue.

In addition, environmental cues such as verbal prompts, reminders notes, timers, lists, or scheduled alarms may be necessary to help school-age children remember to shift their attention when T1D tasks need to be done. Given their increased ability to follow multi-step commands and work toward a goal, some school-aged children can select preferred rewards to work toward. Younger children will require more immediate rewards, while some older children can work toward larger, longer-term goals.

Adolescent Years: Context-Vulnerable EF

EF Skills in Adolescence

While some EF skills approach mature levels in adolescence (e.g., working memory), executive control may actually become less effective in adolescence due to other developmental changes during this period [30•, 39]. Findings from developmental neurobiology suggest the brain's sensitivity to social-emotional stimuli and rewards may peak before cognitive control has fully matured [40, 41]. It has been argued that the “temporal disjunction” in development of the social-emotional and cognitive control systems creates a higher propensity toward risk-taking and immediate rewards [40, 42], especially in social contexts [43]. At the same time, adolescents typically spend more time away from their families and with friends/peers [44], often putting them in a vulnerable social context that might impede their ability to apply EF skills.

Implications of Adolescent EF Skills for Diabetes Management

Adherence to the demanding T1D regimen typically declines over the adolescent years [45–47]. Because EF skills are approaching maturity, teens may appear ready to take on responsibilities for T1D care and responsibility for diabetes management is often transferred to the adolescent with T1D [47, 48]. However, due to difficulty with EF skills in social contexts, adolescents may have difficulty managing their T1D care when out with friends or when there is a more immediate incentive (e.g., staying in the soccer game rather than stopping to check BG). Many teens with T1D have the ability to plan for diabetes management tasks; however, executing this plan can easily be derailed in social contexts and by more immediate rewards.

Recommendations to Support EF Skills and Diabetes Management in the Adolescent Years

As EF skills are approaching maturity in adolescence, parents can allow their teen to take more responsibilities for T1D care, while knowing the adolescent will likely make mistakes. It is important to transition tasks incrementally and with adequate parental monitoring [48]. Continued parental monitoring is essential, as parents may need to provide more assistance or temporally regain responsibility for T1D tasks, depending on the teen's ability and motivation to manage T1D tasks. To support a teen's developing independence and EF skills, Guare, Dawson, and Guare recommend allowing the adolescent enough space to work through problems and make mistakes, while at the same time providing enough support to avoid major failures [45]. However, the threshold for a "major failure" might be lower for adolescents with T1D, as serious health risks (e.g., severe hypo- or hyperglycemia) can occur with diabetes management errors. For all adolescents, risky behavior is the leading cause of morbidity and mortality (e.g., car accidents, sexually transmitted diseases [49]), and having T1D creates additional opportunities for risk (e.g., driving without first checking BG). Given adolescents' greater propensity for risk-taking, parents are recommended to clearly communicate and enforce expectations around diabetes care to reduce the chance of serious T1D-related consequences. Parents can establish rules for T1D-related behaviors that are non-negotiable, such as always checking blood glucose before driving, and provide the teen with more control over other aspects of care, such as when to check BG at other times in the day. Nevertheless, a caution should be noted: an adolescent who experiments with his/her T1D care (e.g., fewer BG checks) and does not experience an immediate adverse consequence (e.g., still feels normal) may be more willing to take increased risks in the future. Thus, close parent involvement and monitoring of adolescents' T1D management behaviors are essential to ensure safety and support while autonomy grows [50].

Because most teens show good understanding of diabetes management and the benefits of good glycemic control, it is natural for parents and health-care providers to become disappointed or frustrated when they do not manage their T1D care perfectly. However, retaining a neutral tone when discussing T1D care is important for maintaining a collaborative relationship that can support optimal care. Parents can act as a safety net when adolescents make a mistake, but the adolescent must feel comfortable telling the parent he/she made the mistake (e.g., calling the parent because diabetes supplies were left at home).

Emerging Adulthood: Taxed EF

EF Skills in Emerging Adulthood

Executive control neural networks continue to mature throughout early adulthood, finally reaching maturity by one's mid-to-late twenties [51]. As a result, the risk- and reward-seeking behavior that characterizes adolescence begins to taper off, and young adults turn their attention to becoming increasingly independent. This developmental period, termed "emerging adulthood" [52] has been identified as a time of dramatically decreased parental supervision, developing self-sufficiency, identity exploration, and transition (e.g., changes in employment, education, location, insurance). In fact, many young adults find themselves to be completely responsible for the tasks of daily living for the first time in their lives, as they are often living away from family and childhood friends. Thus, emerging adults may find themselves navigating new situations on their own with EF skills that still may not have reached full maturity.

Implications of Emerging Adulthood EF Skills for Diabetes Management

Because of the decrease in caregiver and peer support [53, 54] and the increase in personal responsibilities, a young adult's resources for managing diabetes may become sorely taxed. Many young adults will find themselves responsible for making clinic appointments, refilling prescriptions, and finding and managing insurance on their own, often for the first time in their lives. Errors or omissions in diabetes management may therefore become more likely [55]. With new environments and responsibilities, emerging adults will likely have to continuously re-evaluate their plan for integrating T1D care into everyday activities. In fact, in a qualitative study, young adults identified "thinking and planning strategically" as an important part of diabetes management during transitions [56]. Moreover, with changes in location and employment, emerging adults may need to establish new social supports who can help with diabetes management (e.g., roommates, significant others).

Recommendations to Support EF Skills and Diabetes Management in Emerging Adulthood

Structured reminders may help young adults attend to diabetes management needs in the face of many competing demands. For example, phone or text-message alarms can provide helpful reminders to complete tasks [57, 58], especially those that are infrequent or occur during busy times. Strategies to enhance organization are also useful, such as using electronic or visibly posted calendars populated with upcoming clinic appointments or dates to re-order supplies.

Emotional and hands-on support from family and friends are highly valuable during this period. For example, young adults may consider delegating temporary responsibility to others when they feel overwhelmed by responsibilities (e.g., having parents order supplies during college mid-terms). Friends, significant others, and family members can help brainstorm the tasks for which they can offer assistance, such as attending a clinic visit with the young adult to take notes of the providers' recommendations, or reminding the young adult to check his/her blood glucose periodically at a concert. Parents and providers may be helpful in problem-solving new or difficult situations (e.g., how to plan for BG checks during work hours).

Adulthood: Plateau at the Peak of EF

EF Skills in Adulthood

By the late twenties, it is generally believed EF skills reach a plateau and remain consistent until older adulthood [30•, 59]. Most adults are able to set goals and strategies for achieving them, monitor their own behaviors, benefit from feedback, and organize themselves and their environment in a way that is conducive to their lifestyle. Moreover, compared to younger ages, peoples' lives tend to stabilize in adulthood, with fewer transitions and changes in work and personal relationships. Still, there will be times EF skills are taxed, such as in new situations, stressful times, or during periods of exhaustion or family crises.

Implications of Adult EF Skills for Diabetes Management

Adults with T1D are able to use their mature EF skills to better integrate T1D management into daily routines, and can plan for contingencies and organize their lives in a way that facilitates diabetes self-care. Adult's mature EF skills may be reflected in their diabetes care, which can lead to improved glycemic control in adulthood [60]. Many adults will have a more consistent and predictable daily schedule, which may lend itself well to integrating T1D care. However, because adults can rely on a predictable schedule for cues or reminders for T1D care (e.g., always checking BG before an afternoon meeting), they may need additional reminders or cues when schedules change (e.g., on vacation, new job).

Recommendations to Support EF and Diabetes Management in the Adult Years

Although EF skills typically reach a mature plateau in adulthood, strategies to improve the application of EF skills to diabetes tasks may offer additional benefit. When faced with a long-term goal, Barkley and Benton [55] recommend people create smaller steps toward the larger goal. For example, if an adult wishes to lower his A1c by 1 %, he can identify small, achievable behavioral steps to reach this goal (e.g., checking his BG one more time a day) and give himself small rewards for each small objective met (e.g., each week he successfully conducts one additional check per day). Additionally, environmental supports, such as watch or phone alarms may help to maintain a regular schedule for injections or blood glucose monitoring, particularly when the adult is outside of their typical routine (e.g., on vacation).

Older Adulthood: Declining EF

EF Skills in Older Adulthood

Many older adults show a slow decline in EF skills [30•, 61–63]. This decline does not occur at the same rate for all aspects of EF skills, and there are many individual differences [64]. Moreover, EF skills may fluctuate, with better functioning evident on some days but not others. It is not always clear whether declines are specific to EF or part of a broader pattern of normal age-related declines in cognition that include processing speed, intelligence, memory, visual-spatial skills, and attention (see [64] for a review). Cognitive declines may eventually make additional supports for daily living necessary, which can be quite challenging for adults who have been taking care of themselves and their health-care needs independently for many years. As EF skills decline, older adults may be less aware of their declining abilities, and therefore less likely to request (or accept) assistance [64].

Implications of Late Adulthood EF Skills for Diabetes Management

Due to declining EF skills, older adults may have more difficulty with planning and organizing diabetes management tasks. It may also be more difficult to apply lessons learned in previous diabetes management experiences (e.g., adjusting basal insulin doses when ill or during periods of reduced activity). Older adults will likely need hands-on support from others to supplement their diminishing EF skills. If decline in EF skills goes unrecognized and unsupported, the difficulties of managing T1D tasks could result in negative health outcomes [6••].

Recommendations to Support EF Skills and Diabetes Management in the Older Adulthood Years

Identifying T1D patients with decline in EF skills is essential to determine and deliver needed supports. Koekkoek and colleagues discuss recommendations for identifying and assessing cognitive decline in older adults with T1D [6••]. To support these needs, strategies to externalize important information may be useful. For example, it may be helpful to create clear and simply written rules or guidelines for older adults to consult when decisions need to be made related to diabetes management. Posting these guidelines in an easily accessible location such as on the refrigerator or in a wallet can help cue older adults to consult the guides. Reminders to complete diabetes tasks may also be useful, such as phone alarms, phone calls or verbal reminders from friends and family, or clearly posted notes on a calendar. Finally, friends, family members, the diabetes care team, and others in the community (e.g., clergy, pharmacist) may all play a role in providing hands-on support. Assistance with diabetes-related problem-solving is particularly important when similar errors are being made repeatedly. It is important to balance providing directive support with maintaining respect for older adults' autonomy and self-image, and open conversations with older adults about their needs can allow them the opportunity to participate in developing these important support plans.

When Executive Functioning Problems are More Than a Diabetes Management Problem

For some people, difficulty managing T1D may be a symptom of a more pervasive, underlying problem. Behaviors such as disorganization, procrastination, forgetfulness, making careless mistakes, avoiding projects, losing belongings, and failure to follow through on instructions may suggest an individual is experiencing a clinically significant level of EF difficulty that is outside the expected developmental trajectory [65]. If there are concerns about EF skills, it is recommended the person undergo a formal evaluation, ideally by a neuropsychologist (or by a psychologist or psychiatrist). Executive dysfunction can be a significant problem on its own, or could be an indicator of another disorder with overlapping symptoms, such as attention deficit hyperactivity disorder (ADHD), major depression, or dementia [65, 66]. Comprehensive assessment will lead to proper recommendations and treatment.

Executive dysfunction is a significant component of ADHD, as people with ADHD generally exhibit weaker EF skills [67]. Given the high prevalence of ADHD in the general population [65], it is likely that ADHD and T1D will co-occur in some individuals, and the combination of these two conditions has the potential for significant problems with T1D adherence [68, 69]. Effective and empirically supported treatments for ADHD are available (e.g., behavioral therapy and/or medication), but behavioral interventions may need to be tailored to be diabetes specific. Sanchez, Chronis, and Hunter successfully adapted a behavioral intervention to improve adherence in two patients with combined ADHD and T1D [68].

Executive dysfunction may occur not only in the patient, but in the caregiver as well, particularly since disorders like ADHD are highly heritable [65]. Thus, it is possible that a youth with T1D and executive dysfunction might also have a caregiver with executive dysfunction. The recommendations provided above are largely reliant on caregiver support. Thus, caregivers may also need to be evaluated and treated if they lack the EF skills needed to support their dependent's T1D care.

Conclusions

The field is at the beginning of understanding the relations between EF skills and diabetes management behaviors. A recent review of research in T1D and EF identified the following conclusions: a relation between stronger EF and greater adherence is supported and demonstrates small to medium effect sizes (r=0.27–0.66). However, these findings are inconsistent across studies, as some studies used different subscales or composite scores of EF or found different results based on gender [5••]. Thus, more research is needed to better understand this association. One general conclusion is that the complexities of diabetes management can often stretch a person's EF skills. The literature on interventions for patients with frontal lobe injuries and dysfunction highlights the importance of external supports for compensating for executive difficulties [70]. Perhaps for similar reasons, external supports from parents and other family members can be crucially important for diabetes management [71], although the type and degree of appropriate support will differ at different points throughout the lifespan.

In the current paper, we drew on the EF literature and our clinical experiences to describe EF skills that may be most relevant for managing T1D tasks across the lifespan. However, rigorous research is needed to better understand the ways in which specific EF skills influence T1D management and the most effective adherence promotion strategies consistent with EF development across the lifespan. There are many things health-care providers can do to address concerns about EF (see Table 2). Once a more comprehensive understanding of the complex relation between EF and T1D management is reached, clinical recommendations may be tailored to address more specific concerns.

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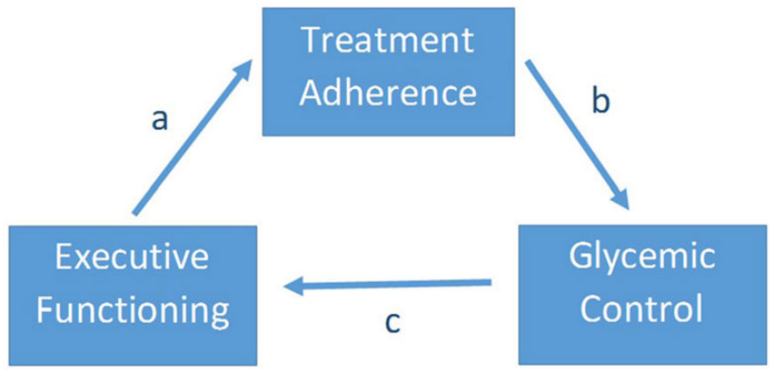

Fig. 1.
Proposed bidirectional relation between executive functioning and diabetes adherence

Table 1

Aspects of executive functioning in diabetes management

Domain	Definition	Example diabetes task: bolusing insulin
Attentional control	• Paying attention to one thing, while ignoring other aspects of the environment	• Sustain attention long enough to complete bolus, while ignoring other environmental stimuli (e.g., TV, conversations)
	• Focusing for a prolonged period of time	• Correctly execute steps of checking BG, calculating carbs, and giving insulin)
	• Monitoring actions, so that plans are executed in the correct order and errors are identified	Double check to ensure steps have been executed correctly (e.g., the correct BG number was entered into pump, or the correct I:C ratio was used)
	• Delaying gratification and thinking before acting	• Wait several minutes to eat after insulin has been given
Cognitive flexibility	• Shifting between tasks	• A person may be engaged in conversation at the dinner table and need to stop the conversation and switch gears to diabetes care
	• Learning from mistakes	• Take into account previous experiences (e.g., knowing to give less insulin if they know their BG goes low after exercising)
	• Devising alternative strategies	• Calculate insulin dose using mental math
	• Processing multiple sources of information concurrently (multi-tasking)	• Adapt when at a new restaurant and eating a new meal
	• Temporarily storing and manipulating information	
Goal setting	• Planning ahead	• Plan ahead to order supplies to ensure you have a working pump, insulin, and information needed available (e.g., I:C ratio)
	• Anticipating future events	• Anticipate when and how you will bolus (e.g., planning time to fit in a bolus in between class and lunch)
	• Formulating a goal	• Keep supplies organized and available when you need them (e.g., keep extra insulin at school in case something happens to current bottle)
	• Devising a sequence of steps to achieve a goal	
	• Arranging complex information in a logical, systematic, and strategic manner.	

BG blood glucose, *I:C* insulin to carb ratio. Domains and definitions [22]

Table 2

Tips for health-care providers in working with families living with T1D

How providers can support EF
• Consider EF contributors to adherence problems
• Provide developmentally appropriate EF expectations for T1D management
• Familiarize yourself with available organizational tools (e.g., apps) to recommend
• Adjust T1D regimen to reflect individual's EF skills and degree of family support
• Guide patients in identifying people to offer support or to help with T1D tasks
• Screen for EF concerns: currently, the only diabetes-specific measure of EF is DREFS [72•]. May be most helpful when used in consultation with psychologist/neuropsychologist.
• Identify pediatric or adult psychologist or neuropsychologist for referrals for further assessment