



## Review Article

# Cognitive-behavioral Therapy for Medical Non-adherence: A Topical Review and Clinical Recommendations



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## Abstract

Medication non-adherence among youth with chronic health conditions is a healthcare crisis in the United States. Nearly 20% of youth experience a chronic illness, yet most do not comply with their treatment regimen. Various challenges to adherence arise, such as not understanding the purpose of treatment, painful or difficult administration, forgetfulness, and mood disorders such as anxiety. Cognitive behavioral therapy (CBT) is an empirically supported approach to increasing treatment adherence. Modular CBT incorporates psychoeducation, cognitive restructuring, and behavioral experiments to promote better disease management. This article focuses on the application of CBT to four medical conditions characterized by elevated levels of non-adherence: pill-swallowing difficulties, asthma, type 1 diabetes, and inflammatory bowel disease in youth. The review integrates findings on contextual issues (e.g., ethnocultural variations, the impact of the COVID-19 pandemic), research on non-adherence, and CBT outcome studies. Additionally, limitations of the existing literature and training recommendations are provided.

## Introduction

Nearly 20 percent of youth in the United States struggle with at least one chronic health condition.<sup>1</sup> However, medical adherence remains a widespread problem. Non-adherence is defined as “the willingness and ability of a person to follow instructions to take medications as prescribed, to attend scheduled clinic appointments, and to complete recommended investigations (p.797)”.<sup>2</sup> Treatment burden refers to the challenges patients face when managing their disease.<sup>3</sup> Often, a heavy treatment burden compromises adherence to prescribed treatment routines.

Carmody *et al.*<sup>4</sup> found that up to 75% of youth with chronic illnesses do not adhere to their medical treatment. Non-adherence results in undesirable outcomes such as toxicity, poor functioning, and death.<sup>4,5</sup> Moreover, this is a costly problem, contributing to a \$300 billion increase in healthcare costs.<sup>6</sup> Adolescents, in particular, struggle with adherence.<sup>7</sup> Socially, they teeter between dependence and independence, relying on caregivers to help them access healthcare while frequently coming into conflict with them.<sup>8</sup> Pediatric pa-

tients’ lack of understanding of the need for medication, difficult or painful administration procedures, forgetfulness, and trouble taking medicine on their own compromise their disease management.<sup>5</sup> Therefore, effective methods to improve pediatric patients’ willingness to follow prescribed regimens are necessary. Fortunately, cognitive behavioral therapy (CBT) spectrum approaches offer considerable promise for addressing misunderstandings, misperceptions, forgetfulness, and skill deficits, as well as reducing clinical sequelae associated with anxiety, depression, pain, and disruptive behaviors. This review focuses on the application of CBT to improve medical adherence in pediatric patients diagnosed with pill-swallowing difficulties, asthma, diabetes, and inflammatory bowel disease (IBD). The article integrates five key sections to achieve its aims. First, it describes the impact of contextual variables, such as sociocultural background and the disruptive influences of the COVID-19 pandemic, on pediatric patients’ medication adherence. Second, it provides a brief explanation of CBT for pharmacologists who may be unfamiliar with this powerful psychosocial intervention. The third section delineates various adherence issues in pediatric patients diagnosed with pill-swallowing difficulties, asthma, type 1 diabetes (T1D), and IBD, as well as their management through CBT. Limitations of the research and future directions are outlined. Finally, the review concludes with implications for training in and delivering adherence-enhancing interventions.

**Keywords:** Cognitive behavioral therapy; Pediatric patients; Non-adherence; Medication; Type 1 diabetes; Asthma; Inflammatory bowel disease.

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## Contextual variables

Pediatric patients’ ability to take medication is often impacted by

age, disability, cultural background, and behavioral problems.<sup>9</sup> Generally, low levels of treatment adherence are more prevalent among families from marginalized communities.<sup>10,11</sup> Unsurprisingly, individuals from these groups report less trust in the healthcare system.<sup>12</sup> Language proficiency and difficulty comprehending medical jargon also affect patients and families from non-native-speaking marginalized communities.<sup>11,13</sup>

The COVID-19 pandemic undeniably represented a disruptive force in patients' lives.<sup>12–17</sup> Quarantines imposed during the pandemic disrupted routines and schedules,<sup>18</sup> making it difficult for patients to attend medical appointments, receive proper doses at school, and secure adequate insurance coverage.<sup>18</sup> Youth diagnosed with asthma, IBD, and T1D reported increased stress and adherence problems during the outbreak.<sup>14,19–21</sup>

Additionally, the COVID-19 crisis amplified existing health disparities.<sup>12,13,16,18,22</sup> Black, Indigenous, and people of color (hereinafter referred to as BIPOC) experienced greater morbidity and mortality during COVID-19.<sup>23</sup> These populations often had less access to healthcare, fewer opportunities for remote work, lived in crowded homes, served as front-line workers, and had pre-existing medical conditions that exacerbated viral infections.<sup>12</sup> Children with pediatric T1D from financially disadvantaged families suffered worse glycemic control during the pandemic due to reduced access to insulin and glucose monitoring strips.<sup>24</sup> Finally, during the COVID-19 pandemic, reduced healthcare capacity and disruptions in care disproportionately affected disadvantaged groups, exacerbating reduced medication adherence.<sup>22</sup>

In sum, CBT should be applied in a contextually responsive manner. These interventions are most effective when delivered with an understanding of existing health disparities, historical patterns of marginalization, socioeconomic status, and access to healthcare. Additionally, practitioners should consider the impact of the COVID-19 pandemic on disease management.

### Brief overview of CBT

CBT is an empirically supported form of psychotherapy with a long history of treatment success for various disorders in diverse populations.<sup>25,26</sup> More specifically, CBT is increasingly applied to pediatric patients.<sup>27,28</sup> Classical, operant, and social learning theory paradigms, as well as cognitive science, form the conceptual nuclei of the approach.<sup>27</sup>

CBT is considered a gold standard for treating children and adolescents diagnosed with internalizing disorders.<sup>29</sup> Large effect sizes have been reported for reducing depression at post-test ( $g = 1.31$ ), three-month follow-up ( $g = 1.37$ ), and six-month follow-up ( $g = 1.92$ ).<sup>29</sup> The same meta-analysis found robust effects for decreasing anxiety symptoms at post-test ( $g = 1.75$ ), three-month ( $g = 1.61$ ), six-month ( $g = 1.97$ ), and one-year ( $g = 2.02$ ) follow-ups. Notably, the effect sizes increased over time, reflecting good treatment durability. Externalizing disorders (e.g., behavior problems, oppositionality, aggression, non-compliance) are also well treated by CBT.<sup>30</sup> A brief behavioral therapy for pediatric anxiety and depression delivered in primary care settings resulted in clinical improvements in functioning ( $B = 0.44$ ,  $p < 0.001$ ,  $d = 0.50$ ).<sup>31</sup> The effects of this brief intervention appeared stronger for anxiety ( $f = 0.21$ ) than for depression ( $f = 0.05$ ).<sup>32</sup> In sum, many interventions for medical non-adherence are based on CBT spectrum approaches.<sup>7,33–37</sup>

A modular approach to CBT is increasingly recommended.<sup>38,39</sup> Modular CBT handpicks the most powerful change-makers from the empirical literature and assembles them into conceptually ho-

mogeneous clusters. Accordingly, the model is theoretically pure yet technically eclectic. There are four intervention modules: psychoeducation, basic behavioral tasks, cognitive restructuring, and behavioral experiments. Each of these components is guided conceptually by functional analysis.

Since CBT is rooted in learning theory and cognitive science, functional analysis is a core element of the approach.<sup>40,41</sup> Functional analysis represents “a scientific approach to the individual”.<sup>41</sup> Several factors are synthesized into this framework, including antecedents, target behaviors, and consequences. These elements link together to identify initiating, maintaining, and exacerbating conditions.<sup>41</sup> Antecedents are the stimuli that trigger and/or set the stage for target behaviors to occur. Target behaviors are the readily apparent actions that clinicians want to increase or decrease. “Private events such as thoughts, feelings, and physiological events can be entered into a functional analysis as target behaviors (p.235)”.<sup>40</sup> Consequences include positive reinforcement, negative reinforcement, response cost procedures, and punishers. Positive and negative reinforcers make behavior more likely, whereas response cost and punishment decrease the frequency of behavior. Based on the results of the functional analysis, an intervention plan including psychoeducation, basic behavioral tasks, cognitive restructuring, and behavioral experiments is mapped out.

Psychoeducation focuses on providing information about diagnoses, presenting complaints and courses of treatment, and acquiring skills for adaptive functioning. Psychoeducation with pediatric patients diagnosed with T1D, asthma, and IBD, as well as those presenting with pill-swallowing difficulties, involves teaching patients about their clinical condition, medication benefits/side effects, and consequences of non-adherence. In CBT, skills are acquired in psychoeducation and then applied through basic behavioral tasks, cognitive restructuring, and behavioral experiment modules.

Basic behavioral tasks are procedures focused directly on pediatric patients' observable actions. They are rooted in classical, operant, and social learning foundations. Behavioral contracting and reinforcement-based interventions have a long tradition of ameliorating non-adherence.<sup>40,42</sup> Dialectical behavioral therapy skills such as radical acceptance and distress tolerance techniques have shown success in managing non-adherence.<sup>34,35</sup>

Problem-solving, self-instruction, and rational analysis are common cognitive restructuring procedures. Cognitive restructuring identifies and modifies pediatric patients' beliefs about their clinical condition, prescribed treatment regimen, and expected outcomes. Additionally, if patients are experiencing depression and anxiety, cognitive restructuring might be deployed to mitigate distress that compromises adherence.

Behavioral experiments and exposure-based interventions are designed to help young patients try out new action tendencies and develop new habits. These methods are experiential exercises that help young patients apply their acquired skills. For instance, a behavioral experiment might involve a child who does not take medication due to taste aversion being invited to chew some cinnamon-flavored gum, take the medicine, and see if the gum diluted the unpleasant taste.<sup>43</sup>

### Applying CBT to non-adherence in pill swallowing, diabetes, asthma, and IBD

#### *CBT applied to pill swallowing*

Liquid medications are often prescribed for pediatric patients.<sup>9</sup>

However, tablet medications offer several advantages over liquid prescriptions,<sup>9,44–46</sup> including being less expensive, more convenient, and safer.<sup>46</sup> Liquid medications also need to be refrigerated and often taste awful.<sup>44,45</sup> Tablets, on the other hand, are more suitable and can be coated to mitigate taste aversion.<sup>9</sup> Despite these benefits, pill-swallowing difficulties are prevalent among pediatric patients, leading to additional problems,<sup>45,47,48</sup> such as longer hospital stays, poorer symptom control, and increased family conflict.<sup>47</sup> Factors contributing to pill-swallowing difficulties include fear of choking, lack of motivation, defiance, mood disturbances, and poor swallowing technique.<sup>45</sup>

Pill swallowing is an acquired skill, typically learned between the ages of eight to ten.<sup>49</sup> However, children over the age of five can usually acquire this skill relatively easily.<sup>46</sup> The Kidzmed project, a colorful, user-friendly, and efficient e-learning platform, was taught to student pharmacists to enhance children's pill-swallowing skills.<sup>44,46</sup> Post-course evaluations indicated that Kidzmed was a viable tool for orienting pharmacists to the process of teaching children swallowing skills. In an open trial investigating the feasibility of pills for children aged four to twelve, 6 mm, 8 mm, and 10 mm tablets were found to be acceptable.<sup>9</sup> Older children were better able to swallow pills than younger peers, but younger patients who successfully swallowed the 6 mm tablet were also able to ingest the 8 mm and 10 mm tablets. This led Bracken and colleagues to conclude there was an "association between tablet naivety and the ability to swallow the pill (p.9)".<sup>9</sup> Therefore, teaching children to swallow pills at an early age is recommended.<sup>47</sup>

Behavioral approaches, including positive reinforcement and graduated practice augmented with play, comics, and videos, have been successful in facilitating pill swallowing. Eighty-four percent of patients successfully switched from liquid to tablet medication using these methods.<sup>46</sup> Additionally, 87% of children learned to swallow pills in a short 14.5-m session involving behavioral techniques.<sup>48</sup> Typical behavioral packages aimed at improving pill swallowing include shaping, modeling, stimulus fading, and graduated exposure.<sup>45</sup> Sexton *et al.*<sup>45</sup> found that 73% of pediatric patients were able to swallow a 200 mg or larger gel cap after behavioral training. This study yielded several behavioral and self-instructional recommendations, such as using cake decorating sprinkles, putting the sprinkles in a pill case or bottle, scheduling pill-swallowing practice after a light meal, and using language like "next pill" rather than "bigger pill" when the graduated practice exercises increased in challenge level.

### **CBT applied to asthma management**

Inhaled corticosteroids (ICSs), inhaled beta-agonists, metaproterenol, and theophylline are common medications used in pediatric asthma management.<sup>40</sup> However, 8% to 22% of pediatric patients do not use the inhaler correctly.<sup>50</sup> Poor adherence to asthma treatment leads to increased risks of exacerbations, reduced disease management, more acute care visits, higher use of rescue medications, school absences, lower quality of life, and increased financial burden.<sup>40,51–54</sup> Improper asthma inhaler use by pediatric patients results in \$7–15 billion in lost costs.<sup>50</sup> When adherence levels rise to 75–80%, a cascade of positive outcomes is observed.<sup>53</sup>

Similar to other chronic medical conditions, adherence to asthma management routines declines during adolescence. Kaplan and Price identified several adolescent-specific factors that contribute to lower adherence rates in pediatric asthma patients.<sup>53</sup> These include the desire for independence, organizational difficulties, time management problems, lack of involvement in decision-making, low motivation, forgetfulness, stigma, perceptions of treatment in-

effectiveness, risk-taking behavior, and the presence of comorbid psychiatric illnesses.

Culturally and linguistically diverse pediatric patients routinely demonstrate poorer adherence to asthma management protocols.<sup>5,51</sup> Adherence rates for asthma treatment are only 50% for children and 25% for urban minority youth.<sup>52,55</sup> For instance, a study examining inhaler use in Mexican and Puerto Rican pediatric patients found that 78% of the youth exhibited poor adherence, with rates higher among Puerto Rican youth than their Mexican counterparts.<sup>51</sup>

A peer-led program for minority adolescents living in urban areas resulted in increased quality of life and asthma control at a 15-month follow-up.<sup>56</sup> Jeminiwa *et al.*<sup>52</sup> conducted a systematic review to determine the effectiveness of eHealth interventions for increasing ICS adherence in asthma patients. They concluded that eHealth interventions are effective at improving ICS adherence compared to control interventions (SMD = 0.41, 95% CI = 0.02–0.79). mHealth interventions showed a moderate positive effect on medication adherence compared to treatment-as-usual (SMD = 0.96, 95% CI = 0.28–1.64). A pilot study investigating an mHealth intervention for urban minority youth (age of five to eleven years) combined with ICS adherence incentives found it to be feasible,<sup>55</sup> acceptable, and effective. Adherence improved at one-month evaluation points (95% CI <sup>33,61</sup>,  $p < 0.001$ ). Patients in the study carried a history of multiple hospitalizations per year (Mean = 2.9 hospitalizations, but over the evaluation period, emergency department visits and hospitalizations were dramatically reduced).

Behavioral interventions are crucial in addressing medication non-adherence.<sup>57</sup> A recent meta-analysis examining digital interventions containing behavioral components found that 87% of these interventions improved adherence and 53% saw improved health outcomes. The behavioral components across these projects included behavior change strategies using personalized text messages. The ADAPT program, which integrates motivation and behavioral techniques, also shows promise in increasing adherence.<sup>54</sup>

Sweeney *et al.*<sup>58</sup> conducted a meta-analysis of 24 articles concerning the treatment of asthma in underserved minoritized youth ( $n = 4,297$ ; African American: 76.2%, Puerto Rican, Hispanic, Latinx: 9.5%, White: 9.5%). The 11 articles that found significant improvements included various intervention components such as tailored, individualized consultations (seven of the 11 articles, 63.6%), educational and/or behavioral elements (10 of the 11 articles, 90.9%), incorporation of family systems (seven of the 11 articles, 63.6%), healthcare system aspects (five of the 11 articles, 45.5%), technological delivery or administration (four of the 11 articles, 36.4%), and Spanish-language versions (three of the 11 articles, 27.3%). Recommended strategies included adherence tracking measures, self-monitoring skills, training in goal setting, and problem-solving. Lin *et al.*<sup>59</sup> conducted an adherence monitoring and behavioral intervention for children in low-income households using virtual web-based treatment, contributing to better medication adherence. Finally, the Teach-to-Goal program, which integrates psychoeducation, self-instruction, and modeling with feedback to teach proper inhaler use, showed considerable promise.<sup>50</sup>

### **CBT applied to diabetes management**

Blood glucose monitoring, insulin, diet, and exercise are often prescribed to treat T1D.<sup>40</sup> Additionally, continuous glucose monitoring and fast glucose monitoring systems can improve glycemic control.<sup>24,60</sup> Nevertheless, diabetes management is particularly challenging for adolescents,<sup>61</sup> with recent data showing that only 17% of teens meet their glycemic thresholds.<sup>62</sup> Elevations in the



Generalized Anxiety Disorder and School Avoidance factors of the Screen for Child Anxiety Related Emotional Disorders are associated with poorer adherence in pediatric patients.<sup>63</sup>

Fortunately, CBT is considered effective in improving diabetes self-management in pediatric patients.<sup>64</sup> Specifically, behavioral interventions aimed at strengthening adherence patterns are supported. Various conventional and creative applications of positive reinforcement show promise. Traditional behavioral techniques, such as contingent praise, and more innovative reinforcement systems (e.g., monetary rewards, fish care supplies), yield successful outcomes.<sup>64</sup> In their review, Barry-Menkaus reported that the We-CAN Manage Diabetes program, which integrates problem-solving and communication training, was superior to standard care in improving glycemic control.<sup>64,65</sup> Moreover, a multi-family behavioral intervention focusing on communication training and education yielded beneficial results.<sup>60</sup> These outcomes indicate that diabetes education is most effective when combined with behavioral interventions.<sup>64</sup>

CBT packages resulted in good glycemic control.<sup>66</sup> Goal setting, coping skills, motivational interviewing, and problem-solving interventions also produced improved adherence outcomes.<sup>61,67</sup> Behavioral Family Systems Therapy for Diabetes (hereinafter referred to as BFST-D) fostered better adherence and glycemic control.<sup>68,69</sup> In a clinical study where 42% of patients improved glycemic control,<sup>68</sup> mean HbA1c levels decreased by 1.20% in patients with high pre-test HbA1c readings (1 standard deviation above the mean). Finally, a comprehensive package integrating BFST-D, motivational interviewing, problem-solving, cognitive restructuring, and exposure was deployed to enhance diabetes management.<sup>70</sup>

### **CBT applied to the management of IBD**

IBD represents a chronic idiopathic inflammatory condition with both intestinal and extra-intestinal features, characterized by periods of relapse and remission.<sup>71</sup> IBD prevalence rates are estimated at 71 per 100,000 youths.<sup>72</sup> Medical treatment of IBD typically involves aminosalicylates, thiopurines, recombinant human erythropoietin injections, gluten-free diets, and enteral nutrition.<sup>40</sup> Additionally, disease management includes weekly or biweekly subcutaneous injections as well as regular endoscopies and colonoscopies.<sup>73</sup> Medications are designed to attenuate remission rates and heal intestinal mucosa.<sup>72</sup> Adherence to medical regimens for IBD requires effective disease management strategies, mindfulness of one's needs, and the capacity to navigate emotional distress.<sup>74</sup> However, similar to T1D and asthma, medication adherence is problematic for patients with IBD.<sup>75-78</sup> Sixty-six percent of pediatric patients are non-adherent to their medications.<sup>72</sup> In a more recent study, only 66% of adolescents properly took 80% of their oral medications.<sup>76</sup>

Disease management in pediatric patients is commonly compromised by stress and exposure to trigger foods.<sup>78</sup> Anxiety and depression moderate adherence, with increases in emotional difficulties associated with lower adherence rates.<sup>74</sup> Poor adherence results in many adverse sequelae, including relapses, loss of response to biological agents, increased healthcare costs, higher morbidity/mortality rates, elevated disability levels, and poorer quality of life.<sup>71</sup>

Attendance at medical visits by both parents and children increased their adherence.<sup>79</sup> Non-adherence rates also decrease when families track their progress.<sup>79</sup> When providers explain the rationale, dosage, and side effects of medications, conformity with treatment regimens improves.<sup>79</sup> A notable report found that a single counseling session delivered by pharmacists, focusing on

educating adult patients diagnosed with IBD about their medications, increased receptivity to the prescriptions, and these gains were maintained two years later.<sup>77</sup> The counseling session contributed to increased adherence in severely non-adherent patients ( $p < 0.001$ ). Moreover, participants in this study significantly increased their reported acceptance of medication (CI = 36.6, 69.1,  $p < 0.03$ ). These results are important because interventions by pharmacists can be leveraged to reduce the burden on physicians.<sup>76</sup>

CBT holds the potential for improving adherence and reducing disease-related distress in patients diagnosed with IBD.<sup>71,72,74,80,81</sup> A two-session problem-solving intervention demonstrated effectiveness in improving adolescents' conformity with treatment.<sup>72</sup> A systematic review examining interventions reported that CBT procedures resulted in decreased disease activity and increased coping skills.<sup>74</sup> CBT was also recommended for pediatric patients whose beliefs about their medication or disease compromise their self-management.<sup>36,81,82</sup>

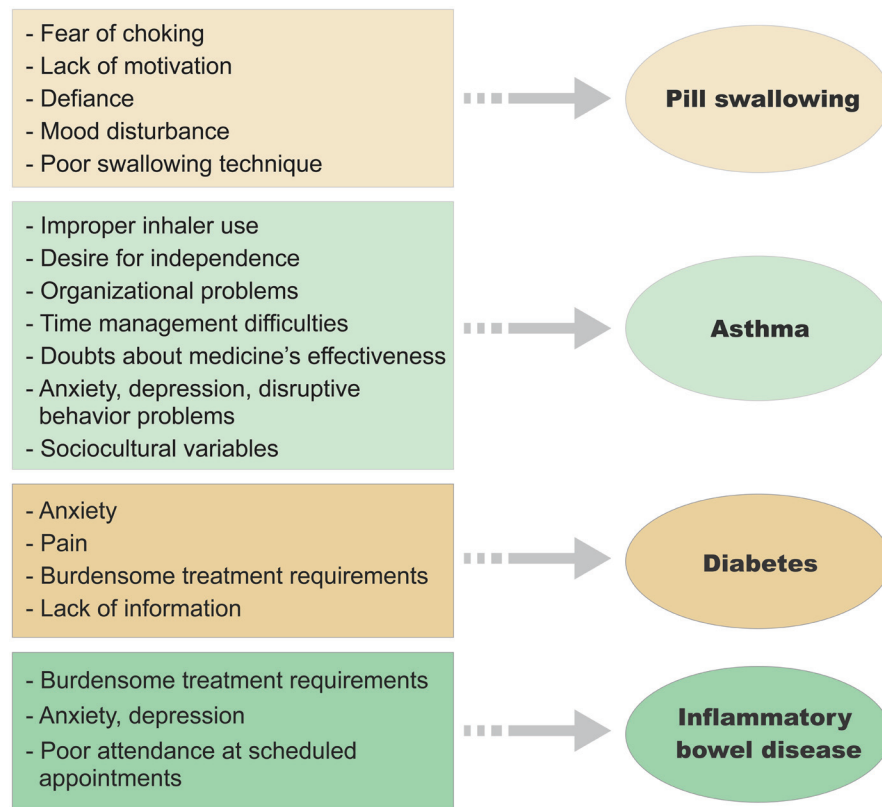
### **Limitations**

Research examining the application of CBT for pediatric patients with pill-swallowing difficulties, T1D, asthma, and IBD adherence problems is an emerging area. While many studies are commendable, they have imperfections and suffer from several limitations. There is widespread criticism of the samples recruited for these studies. Multiple authors noted that the populations sampled did not adequately represent patients from traditionally marginalized groups and suffered from selection bias.<sup>5,6,9,11,17,44,46,48,55,57,59,63,74,83-85</sup> Thus, external validity is questionable, and the findings should be generalized with considerable caution. Specifically, diligent recruitment of BIPOC patients using creative and innovative methods is recommended.<sup>11</sup> Some researchers argued that the statistical analyses are flawed and/or underpowered.<sup>6,74,86</sup> Still others contended that the measurement methods employed were problematic.<sup>6,50,52,57,58</sup> Therefore, employing more sophisticated methods and experimental designs is recommended.

### **Key messages from the literature**

The reviewed literature indicates that sociocultural contexts and emotional, cognitive, and behavioral factors impact pediatric patients' adherence to medication. Pill swallowing appears compromised by fear of choking, lack of motivation, defiance, mood disturbances, and improper swallowing technique. Incorrect use of the inhaler, time management/organizational difficulties, desire for independence, doubts about the medicine's effectiveness, sociocultural variables, as well as anxiety, depression, and disruptive behavior disorders jeopardize adherence in pediatric patients diagnosed with asthma. Good diabetes management is eroded by anxiety, pain, lack of information, and burdensome treatment requirements. Anxiety, depression, perceived treatment burden, and unsatisfactory attendance at scheduled appointments weaken adherence to treatment regimens for patients with IBD. These factors are illustrated in [Figure 1](#).

Fortunately, modular cognitive-behavioral practices are helpful in mitigating these barriers.<sup>37,87</sup> By providing reliable and authoritative information, education/psychoeducation could reduce misunderstandings among pediatric patients and their caregivers, attenuate ambiguity, and increase their sense of empowerment. Basic behavioral tasks, such as reinforcement-based procedures, have a strong record of success in improving swallowing technique, cor-



**Fig. 1. Reasons for non-adherence to medical regimens for pill swallowing, asthma, diabetes, and inflammatory bowel disease.** Each box represents variables that impact adherence (the arrow) to medical regimens for the various conditions indicated by the circles.

rect inhaler use, addressing low motivation, defiance/disruptive behaviors, and enhancing adherence to burdensome procedures. Cognitive restructuring appears valuable in decreasing anxiety and depression, as well as increasing acceptance of pain, which can compromise medication adherence. Exposure-based treatments are credible methods to reduce avoidance behaviors driven by fear, anxiety, and pain. Specific examples of the use of these methods are provided in the following section.

**Clinical intervention and training recommendations**

Methodological limitations notwithstanding, the review yields several recommendations for the clinical training of both professional therapists and individuals who are not behavioral health specialists. This section presents recommendations for psychoeducational, behavioral, cognitive restructuring, and exposure-based interventions.

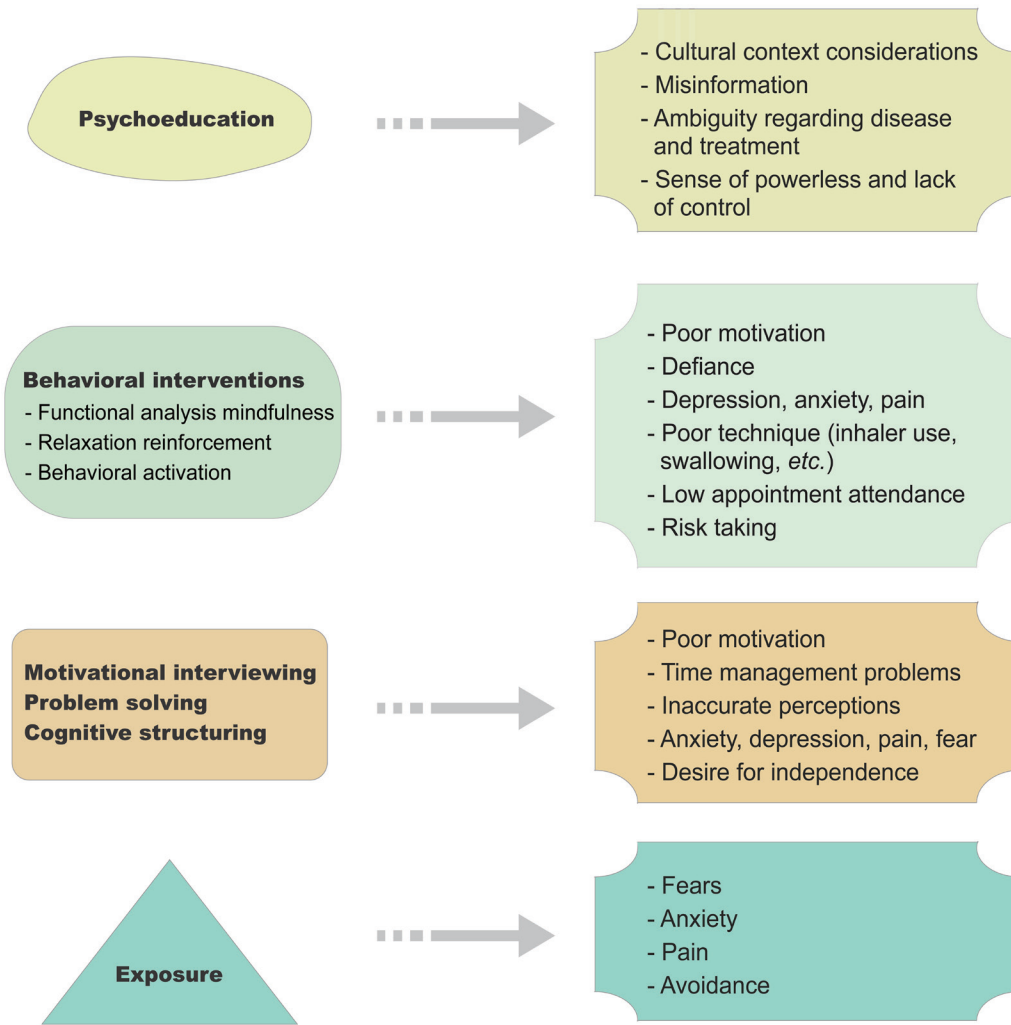
Psychoeducational interventions are unobtrusive and straightforward techniques that can be readily implemented by CBT clinicians and pharmacists. For example, pharmacists, nurses, and physician assistants could be trained in psychoeducational procedures for pill swallowing.<sup>9,11,44,49</sup> In order to fulfill this role, simple, accessible, engaging, and creative educational materials are necessary. This information should be concise and eye-catching. The one-page handouts contained in the empirically successful MATCH-ADTC program represent an excellent model for developing useful resources.<sup>88</sup> The reviewed literature clearly recommends that generic behavioral interventions should be customized

to patients' challenges and contexts.<sup>37</sup> Behavioral techniques may be more challenging for pharmacologists to apply. However, with appropriate training and consultation, it is reasonable for professionals to provide these interventions. Instruction in completing functional analysis is a necessary first step. Functional analysis tailors these procedures to individuals' unique contexts. Fortunately, instruction in functional analysis has been successfully applied to many non-behavioral health professionals and is a cornerstone of parent and teacher training programs.

Operationally defining target behaviors, learning to precisely identify the antecedents (e.g., triggers) to these actions, understanding operant principles (e.g., positive reinforcement, negative reinforcement, response cost) associated with increasing/decreasing behaviors, and practicing plotting the connection between antecedents, behaviors, and consequences are core pedagogical elements (Fig. 2). Functional analysis is akin to a Global Positioning System that carefully situates pediatric patients' behaviors within a personalized context. Figure 3 depicts a sample Functional Analysis map.

After completing the functional analysis, contingency contracts or charts can be designed to increase motivation, inhaler use, pill swallowing, and appointment attendance rates. Simply put, a contingency chart is a formalized agreement with an "If-then" provision (e.g., "If Noah takes his medication as prescribed daily, his mother will award him three points per day, which he can redeem for a reward at the end of the week").

Behavioral activation is a classic intervention aimed at improving euthymic moods.<sup>39</sup> This method involves developing a list of potential mood elevators, rating one's mood before engaging in



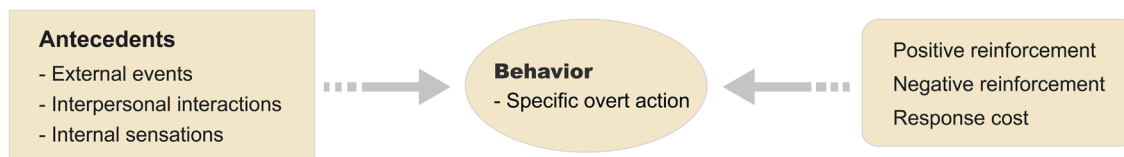
**Fig. 2. Modular CBT components and their targets.** Each shape on the left side of the figure contains a modular cognitive behavioral procedure that targets a specific problem (as represented by the shapes on the right side of the figure) that compromises adherence. CBT, Cognitive-behavioral Therapy.

the activity, completing the activity, rating the mood afterward, and then comparing the pre- and post-test ratings. Consequently, behavioral activation is a favorable means to decrease depressed affect and withdrawal/avoidance. Pharmacologists can expect to apply this intervention after receiving some training.

McClure and colleagues provide several basic exercises and tips to facilitate swallowing and medication adherence.<sup>43</sup> These techniques can be easily learned by individuals who are not behavioral health specialists. Finally, various technological aids (text reminders,

apps, etc.) often enhance basic behavioral procedures.<sup>89</sup> These technological innovations improve access and yield real-time data, but unfortunately, they vary in quality and rely on patients' independent use.<sup>89</sup> Therefore, caution is advised, and familiarity with functional analysis principles is recommended when using these aids.

Competencies in motivational interviewing, problem-solving, and cognitive restructuring are more challenging to develop. Therefore, pharmacologists may wish to refer patients to behavioral health specialists when these methods are indicated. None-



**Fig. 3. Functional analysis map.** This figure illustrates the basic rubric for functional analysis. Antecedents that prompt the target behaviors (e.g., the specific overt actions in the circle) are represented in the rectangular shape. The external consequences that make the behavior more or less likely to occur are in the rounded square shape on the right side. The arrows indicate that behavior is prompted by antecedents and followed by contingent reinforcements or penalties.

**Table 1. Thought record example**

Situation (Trigger)	Feeling	Thought
Having to keep to my prescribed meal plan	Depressed	I can't do this. It is too hard. Even if I do, it doesn't get rid of all the pain. It's hopeless.
Getting the urge to defecate while in class	Anxious	What if I have to go and I lose control or there is not a bathroom?
Taking regular biological injections	Angry	This is unfair. It hurts and it disrupts my schedule. I hate all this hassle! What a pain!!

**Table 2. Example of cognitive restructuring**

Situation	Feeling	Thought	Coping Thought	Re-rate Mood
Getting the urge to defecate while in class	Anxious (8)	What if I have to go to the bathroom and I lose control or there is not a bathroom.	I'm really catastrophizing. I have never lost control while in school and there are plenty of bathrooms. I just need to pay attention to my body instead of thinking the worst.	Anxiety (4)

theless, understanding how these interventions work can facilitate continuity of care. Motivational interviewing integrates empathy, goal planning, obtaining commitment, problem-solving, decisional balance techniques, and self-management.<sup>90</sup> The approach is delivered in a collaborative style that respects patients' autonomy and self-determination. Problem-solving is a clinical and theoretical approach related to motivational interviewing. Common rubrics for problem-solving include specifying the problem, brainstorming viable options, evaluating the long-term/short-term positive and negative consequences, and then making a productive choice among available alternatives.<sup>43</sup>

Cognitive restructuring focuses on reshaping pediatric patients' thoughts, conclusions, judgments, perceptions, and images.<sup>43</sup> The process begins with constructing a thought diary, which involves identifying triggering situations, accompanying feelings with intensity levels, and thoughts (please see Table 1). After completing the thought diary, the CBT clinician and the patient collaboratively work to develop a more accurate and adaptive appraisal. This re-evaluation process is typically done through the Socratic method.<sup>91</sup> Table 2 presents a thought diary with a re-engineered interpretation. Exposure is a powerful intervention that works to decrease avoidance associated with fear, anxiety, and pain.<sup>92–94</sup> Implementing exposure, however, requires considerable training and sophistication. The intervention typically involves creating a hierarchy of distressing items, predicting their level of threat, coaching patients to accept, tolerate, and cope with their discomfort, and comparing their expected level of vulnerability with their actual experience.<sup>43,94</sup> The more patients are surprised by the difference between their anticipated response and what they encountered during the exposure, the more their symptoms improve.<sup>95</sup>

### Future directions

Dismantling studies that identify the most active intervention ingredients that produce gains in adherence are needed.<sup>86</sup> Additionally, comprehensive moderator and mediator analyses would be helpful to determine what works best for whom under specific conditions. Clearly, ethnocultural factors should be included as moderator variables. This approach allows for interventions to be individually tailored to patients, promoting a more personalized and precise approach.<sup>86,87</sup> Finally, technology-based interventions need more rigorous evaluations.

### Conclusions

The research literature examining non-adherence to medical regimens reveals several challenging issues. Adherence is multi-determined and requires personalized interventions. Fortunately, CBT effectively addresses these complexities and offers an efficacious way to reduce non-adherence. Although more sophisticated studies, including moderation and mediational analyses, are necessary, CBT shows considerable promise. Accordingly, it is recommended that healthcare professionals increase their familiarity with this intervention model.

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### Author contributions

Conceptualization, research, writing, revision supervision (RDF); conceptualization, research, writing, revision (MN); research, writing (JZ, AH, AM, AG, ND). All authors agreed the final version of this manuscript.

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