Attention deficit hyperactivity disorder in children and adolescents: Overview of treatment and prognosis

INTRODUCTION

Attention deficit hyperactivity disorder (ADHD) is a disorder that manifests in childhood with symptoms of hyperactivity, impulsivity, and/or inattention. The symptoms affect cognitive, academic, behavioral, emotional, and social functioning [1].

DIAGNOSTIC CRITERIA

Diagnostic criteria for ADHD include symptoms of hyperactivity, impulsivity, and/or inattention that occur in more than one setting and affect function (eg, academic, social, emotional, etc). The evaluation and diagnosis of ADHD is discussed separately. (See "Attention deficit hyperactivity disorder in children and adolescents: Clinical features and diagnosis".)

GENERAL PRINCIPLES

Care coordination — ADHD is a chronic condition and should be managed in a manner similar to other chronic conditions of childhood [2,3]. In addition to regularly monitoring the effectiveness of therapeutic interventions, it is important for primary care clinicians to provide information to the caregivers and child about ADHD, help the caregivers set specific treatment goals, and offer information regarding local support groups if they are available (table 1) [2,4,5]. (See "Children and youth with special health care needs".)

Regular communication between the caregivers and the teachers is important. This can occur through a daily report card or a weekly communication book.

Involvement of patient and caregivers — Treatment of ADHD may involve behavioral interventions, medication, school-based interventions, or psychological interventions alone or in combination. Decisions regarding the choice of therapy should involve the patient (if at least school-aged) and their caregivers. Together with the treating clinician, the patient and caregivers must evaluate the risks and benefits of the various treatment options to determine the optimal treatment strategy [2,3]. (See 'Treatment modalities' below.)

Target goals — The management of children with ADHD centers upon the achievement of target outcomes that are realistic, achievable, and measurable [6]. Specific target outcomes may change over the course of treatment and should be determined in collaboration with the caregivers, child, and school

personnel. Between three and six target outcomes can be addressed at any given time. Progress can be monitored with a daily report card.

Examples of target outcomes include [7]:

●Improved relationships with caregivers, teachers, siblings, or peers (eg, plays without fighting at recess)

●Improved academic performance (eg, completes academic assignments)

●Improved rule following (eg, does not talk back to the teacher)

Treatment of coexisting conditions — As many as one-third of children with ADHD have one or more coexisting condition (eg, learning disorders, oppositional defiant disorder, conduct disorder, anxiety disorder, mood disorders, tics, sleep disorders) [8,9]. It is important to treat coexisting conditions concurrently with ADHD; treatment of coexisting conditions may influence the treatment for ADHD [3]. Adjunctive behavioral, psychological, and pharmacologic interventions may be necessary for managing the full spectrum of symptoms in children with ADHD and coexisting conditions [10].

Treatment of sleep problems may improve ADHD symptoms. In a randomized trial, families of 244 children (5 to 12 years of age) with ADHD and parent-reported moderate to severe sleep problems who met diagnostic criteria for at least one sleep disorder (eg, delayed sleep phase, sleep onset disorder) were assigned to receive a brief behavioral sleep intervention or usual care; 88 percent of children in both groups were receiving pharmacotherapy (predominantly methylphenidate) [11]. The intervention consisted of two consultations about sleep with a trained clinician two weeks apart and a follow-up phone call two weeks later. At the three- and six-month follow-up, children in the intervention group had greater, albeit modest, improvements in ADHD symptoms and teacher-reported behavior than control children. (See "Cognitive and behavioral consequences of sleep disorders in children", section on 'Clinical consequences of sleep deficiency'.)

Indications for referral — ADHD in children 4 to 18 years of age without comorbid conditions can usually be managed by the primary care provider [3]. Indications for referral to or consultation with a specialist (eg, developmental behavioral pediatrician, child neurologist, psychopharmacologist, child psychiatrist, clinical child psychologist) may include [3,4,12]:

●Coexisting psychiatric conditions (eg, oppositional defiant disorder, conduct disorder, substance abuse, emotional problems) (see "Attention deficit hyperactivity disorder in children and adolescents: Clinical features and diagnosis", section on 'Evaluation for coexisting disorders')

●Coexisting neurodevelopmental, neurologic, or medical conditions (eg, seizures, tics, autism spectrum disorder, learning disorders, intellectual disabilities, sleep disorder) (see "Attention deficit hyperactivity disorder in children and adolescents: Clinical features and diagnosis", section on 'Differential diagnosis')

●Lack of response to a controlled trial of stimulant therapy or atomoxetine (see "Attention deficit hyperactivity disorder in children and adolescents: Treatment with medications", section on 'Dose titration')

●Complex psychosocial circumstances (eg, trauma or other adverse childhood experiences)

OVERVIEW OF MANAGEMENT

The recommended treatment strategies for children with ADHD vary according to age [3,13]. The American Academy of Pediatrics [3], American Academy of Child and Adolescent Psychiatry [2], the United Kingdom's National Institute for Health and Care Excellence [14], the Scottish Intercollegiate Guideline Network [13], and the European Network for Hyperkinetic Disorders [15] have developed guidelines or practice parameters for the evaluation and management of children with ADHD. The Society for Developmental and Behavioral Pediatrics have guidelines and process of care algorithms for evaluation and management of children with complex ADHD [10,12]. The recommendations included in this topic review are consistent with the recommendations of these groups. (See 'Society guideline links' below.)

Preschool children — For preschool children (age 4 through 5 years) who meet the diagnostic criteria for ADHD, we recommend parent (caregiver) training in behavior management (PTBM; also known as behavior therapy) rather than medication as the initial therapy [3,13,16]. Behavior therapy can be administered by the caregivers or teachers following consultation with a behavioral therapist. (See "Attention deficit hyperactivity disorder in children and adolescents: Clinical features and diagnosis", section on 'Diagnosis' and 'Psychosocial interventions' below.)

The addition of medication to behavior therapy may be indicated if target behaviors do not improve with behavioral therapy alone and the child's function continues to be impaired. Examples of situations in which it may be warranted to add medication to behavioral therapy for preschool children include [10,17]:

●Expulsion (or threatened expulsion) from preschool or daycare

●Significant risk of injury to self, other children, or caregivers

●Strong family history of ADHD

●Suspected or established central nervous system injury (eg, prenatal alcohol or cocaine exposure)

●ADHD symptoms interfere with other needed therapies

When medication is necessary for preschool children, we suggest methylphenidate rather than amphetamines or nonstimulant medications [2,3,18]. (See "Attention deficit hyperactivity disorder in children and adolescents: Treatment with medications", section on 'Preschool children'.)

Some children diagnosed with ADHD during the preschool or early school years may no longer meet criteria for ADHD after school entry or in the later school years [19]. New diagnoses for such children may include autism spectrum disorder, learning disorders, and anxiety, highlighting the importance of monitoring young children diagnosed with ADHD for other neurodevelopmental and behavioral disorders over time. Comprehensive reevaluation during the school years may be warranted. (See 'Prognosis' below.)

School-age children — For most school-aged children and adolescents (≥6 years of age) who meet the diagnostic criteria for ADHD and specific criteria for medication, we suggest initial treatment with stimulant medication combined with PTBM (behavior therapy) to improve core symptoms and target outcomes [2,3,13,15,16,20,21]. However, nonstimulant medications may be more appropriate for certain children. Comorbid conditions must be considered in selecting a specific treatment approach [10].

The values and preferences of the patient and caregivers are critical factors in deciding whether to initiate medication [3]. The decision of caregivers who choose to decline medication must be respected. (See "Attention deficit hyperactivity disorder in children and adolescents: Treatment with medications", section on 'Choice of agent' and 'Psychosocial interventions' below.)

Children who do not meet ADHD criteria — We recommend behavioral interventions for children with problematic behavior who do not meet the diagnostic criteria for ADHD. (See 'Psychosocial interventions' below.)

Monitoring — ADHD is a chronic disease [3]. Children undergoing treatment for ADHD should be monitored regularly for adherence to the treatment plan, adverse effects of therapy (for those on medications), and response to therapy (eg, the achievement of target goals and the occurrence of core symptoms) [2-4,22]. If the selected management strategy does not result in attainment of the target outcome, the original diagnosis, comorbid conditions, and adherence to management plan should be reevaluated [2]. (See "Attention deficit hyperactivity disorder in children and adolescents: Clinical features and diagnosis", section on 'Evaluation'.)

Adverse effects of medications and monitoring for adverse effects of medications are discussed separately. (See "Pharmacology of drugs used to treat attention deficit hyperactivity disorder in children and adolescents" and "Attention deficit hyperactivity disorder in children and adolescents: Treatment with medications", section on 'Managing stimulant adverse effects'.)

The frequency of follow-up visits depends upon whether the child is receiving medication and how well the core symptoms and target behaviors are being controlled. Children who are not receiving medication should be seen at least twice per year, particularly during critical transitions (eg, into middle school or high school). The monitoring schedule for children receiving medication depends upon the stage of pharmacotherapy [6]. It may range from weekly during the titration stage to every three or six months during the maintenance phase, depending upon adherence, coexisting conditions, and the persistence of symptoms. (See "Attention deficit hyperactivity disorder in children and adolescents: Treatment with medications", section on 'Dose titration'.)

Response to treatment — Response to treatment is demonstrated by objective measurement of reduction in core symptoms and/or improvement in target goals (eg, 40 to 50 percent reduction in core symptoms compared with baseline; decreased proportion of missing assignments from 60 to 20 percent per week) [6]. Core symptoms can be monitored through the use of ADHD-specific rating scales (table 2); target symptoms can be monitored through a daily report card or periodic narrative reports from the child's teacher [6,23]. Caregiver reports correlate poorly with teacher reports and cannot be used as a proxy for teacher reports [24,25]. A toolkit that provides information about daily report cards is available through the National Institute for Children's Health Quality.

Inadequate or lack of response to treatment may be due to [2,6]:

●Coexisting conditions (eg, language or learning disorders, mental health disorder, psychosocial stressor) (see "Attention deficit hyperactivity disorder in children and adolescents: Clinical features and diagnosis", section on 'Evaluation for coexisting disorders')

●Nonadherence to the treatment plan

●Incorrect or incomplete diagnosis (see "Attention deficit hyperactivity disorder in children and adolescents: Clinical features and diagnosis", section on 'Differential diagnosis')

For children with inadequate or lack of response to treatment, repetition of the diagnostic evaluation may be warranted, with increased focus on coexisting conditions that are associated with ADHD or mimic its symptoms (eg, sleep disorders, epilepsy, learning disorders, etc). The nonspecific improvement in behavior that occurs with stimulant medication can mask other problems and/or delay the use of more appropriate interventions (eg, serotonin reuptake inhibitor for depression) [22,26]. (See "Attention deficit hyperactivity disorder in children and adolescents: Clinical features and diagnosis", section on 'Evaluation'.)

TREATMENT MODALITIES

Psychosocial interventions — Psychosocial interventions include modifications in the physical and social environment that are designed to change behavior using rewards and nonpunitive consequences [3,27]. Behavioral management techniques that are used for children with ADHD include positive reinforcement, time-out, response cost (withdrawing rewards or privileges when unwanted or problem behavior occurs), and token economy (a combination of positive reinforcement and response cost) [28].

Psychosocial interventions, particularly behavioral ones, are preferred to medication as the initial intervention for preschool children with ADHD and are adjuncts to medication for school-aged children and adolescents [3,14,29-31]. Behavioral interventions also can be used for children who have problems with inattention, hyperactivity, or impulsivity but do not meet criteria for ADHD [3]. (See "Attention deficit hyperactivity disorder in children and adolescents: Treatment with medications", section on 'Prerequisites' and 'School-age children' above.)

Parent (or caregiver) training in behavior management (PTBM) is aimed at improving parent-child relationships through enhanced parenting techniques [17]. Behavioral interventions are most effective if caregivers understand the principles of behavior therapy (ie, identification of antecedents and altering the consequences of behavior) and the techniques are consistently implemented [17,28]. PTBM therapists or programs (typically eight or more sessions) are available in many communities [6,32].

Clinicians can request references for a suitable behavioral therapist from professional organizations (eg, Association for Behavior and Cognitive Therapies) or ADHD advocacy organizations (eg, Children and Adults with Attention Deficit Hyperactivity Disorder). The Centers for Disease Control and Prevention (CDC) provides additional resources for parents seeking PTBM [32].

Behavioral interventions and environmental changes that can be used by caregivers or teachers to shape the behavior of children with ADHD include [33]:

●Maintaining a daily schedule

●Keeping environmental distractions to a minimum

●Providing specific and logical places for the child to keep their schoolwork, toys, and clothes

●Setting small, reachable goals (see 'Target goals' above)

●Rewarding positive behavior (eg, with a "token economy")

●Identifying unintentional reinforcement of negative behaviors

●Using charts and checklists to help the child stay "on task"

●Limiting choices

●Finding activities in which the child can be successful (eg, hobbies, sports)

●Using calm discipline (eg, time out, distraction, removing the child from the situation)

Additional tips for caregivers of children age 6 to 12 years are available through the National Institute for Children's Health Quality toolkit, free with registration, and the CDC. (See 'Resources' below.)

Standardized training programs for caregivers of preschool children with disruptive behavior disorders (including symptoms of ADHD) that have been evaluated in systematic reviews include [27,34,35]:

- Incredible Years Parenting Program (www.incredibleyears.com/index.asp)

- New Forest Parenting Program (specifically designed to address ADHD symptoms)

- Positive Parenting Program (Triple P)

- Parent-Child Interaction Therapy

- Helping the Noncompliant Child

Adolescents may also benefit from direct skills training [3], which is intended to build the adolescent's skills to meet age-appropriate expectations and functional demands. Direct skills training may include homework organization, time management, study skills, and self-monitoring skills. A systematic review of psychosocial treatment programs for adolescents found small- to medium-sized improvements in parent-rated ADHD symptoms, co-occurring behavioral and emotional symptoms, and interpersonal functioning, but more robust improvements in academic and organizational skills [21].

Evidence supporting behavioral interventions for ADHD is limited. In an individual participant data meta-analysis that included 2233 children and adolescents with ADHD, behavioral interventions (eg, PTBM, classroom interventions, skills training) had small to moderate effects on individual and collective symptoms of ADHD and global impairment in unblinded assessments by parents or teachers [36]. In a separate meta-analysis of randomized trials, PTBM had small to moderate effects on parental outcomes (eg, improved competence or mental health, decreased negative parenting [eg, corporal punishment, harsh discipline]) compared with control [37]. Techniques focused on changing antecedent behavior and reinforcement appeared to be most effective.

Studies of behavior therapy in other populations of children provide indirect evidence of benefit. In a meta-analysis of eight studies in preschool children with disruptive behavior disorders (including children at risk for ADHD), PTBM was associated with improved parent-reported child behavior (standardized mean difference -0.68, 95% CI -0.88 to -0.47) [27]. The standardized mean difference (also called the effect size) describes the extent to which the performance in the treatment group differed

from that in the control group; by consensus, differences of 0.2, 0.5, and 0.8 are considered small, moderate, and large, respectively. The addition of school or daycare interventions to parent-child behavior therapy appeared to have some benefit for children from families of lower socioeconomic status. The long-term effects of behavior therapy for ADHD have not been determined [18].

In most systematic reviews, behavioral interventions alone do not appear to reduce the core symptoms of ADHD in school-aged children but may improve other problem behaviors (eg, aggression, caregiver-child relations) [38-42]. However, two systematic reviews found behavioral interventions to be effective [43,44]. The conclusions of the systematic reviews are limited by the quality of the included studies [39,40,45,46]. Problems include insufficient description of the intervention and the complexity of the child's family, school, social, and peer environments [31].

Pharmacotherapy — We suggest medications with or without behavioral/psychological interventions for most school-aged children (≥6 years) and adolescents who meet diagnostic criteria for ADHD (table 3) [2,3,13]. (See "Attention deficit hyperactivity disorder in children and adolescents: Clinical features and diagnosis", section on 'Diagnosis'.)

We also suggest medications as an adjunct to behavioral interventions for preschool children (age 4 through 5 years) who meet diagnostic criteria for ADHD and fail to respond adequately to behavioral interventions alone. However, the values and preferences of the patient and caregivers are critical factors in deciding whether to initiate medication [3]. The decision of caregivers who choose to decline medication must be respected (see 'Overview of management' above). Comorbid conditions must be taken into account when selecting a specific treatment approach and when evaluating its effectiveness.

In addition to reducing core ADHD symptoms, pharmacotherapy may be associated with reduced risk of mortality, particularly from unnatural causes. (See 'Prognosis' below.)

Treatment of ADHD with medications, including the choice of agent and dose titration, is discussed separately. (See "Attention deficit hyperactivity disorder in children and adolescents: Treatment with medications".)

Combination therapy — Combination therapy uses both psychosocial interventions and medications. Combination therapy may be warranted in preschool children who do not respond to behavioral interventions alone [2]. In a systematic review and a meta-analysis, combination therapy with medications and behavior/psychological therapy was superior to behavior/psychological therapy alone [39,47]. (See 'Preschool children' above.)

Combination therapy may be beneficial for school-aged children and adolescents who have a suboptimal response to pharmacotherapy, have a coexisting condition, or experience stressors in family life [2]. In systematic reviews of randomized trials (including the Multimodal Treatment Study of Children with ADHD), combined medication and behavior treatment was no more effective than medication treatment alone in improving core symptoms of ADHD [39,47,48]. However, children receiving combined treatment may require lower doses of medication and achieve greater improvement in non-ADHD symptoms (eg, oppositional/aggressive, internalizing, teacher-rated social skills, caregiver-child relations, and reading achievement) than children receiving medication alone [21,30,48]. (See 'School-age children' above.)

School-based interventions — School-based interventions may include the provision of tutoring or resource room support (either in an exclusive setting or within the classroom [ie, inclusion classes]), classroom modifications, accommodations, behavioral interventions, or direct skills training [3,21,33,49].

Classroom modifications and accommodations may include having assignments written on the board, sitting near the teacher, having extended time to complete tasks, being allowed to take tests in a less distracting environment, or receiving a private signal from the teacher when the child is "off-task." The teacher's completion of a daily report card facilitates the monitoring of symptoms and the need for changes in the treatment plan. (See 'Response to treatment' above.)

The school also may provide behavior management programs that target ADHD symptoms and/or enhanced academic and social function [3]. Information for teachers of children with ADHD is available through Children and Adults with Attention-Deficit/Hyperactivity Disorder.

Evidence supporting school-based interventions is limited [50,51]. A systematic review [50] found two cohort studies (and one extension) that demonstrated that classroom-based programs to enhance academic skills were effective in improving achievement scores in multiple domains, but the benefits were sustained only as long as the intervention is continued [52-54].

In the United States, ADHD is considered to be a disability under the Individuals with Disabilities Education Act (IDEA [PL-101-476]). Under IDEA, children with ADHD may qualify for special education or related services. Alternatively, they may qualify for appropriate accommodations within the regular classroom setting under Section 504 of the Rehabilitation Act of 1973 (table 4) [49]. In addition, the Americans with Disabilities Act may provide individuals with ADHD reasonable accommodations in secular private schools and post-secondary education (table 5). The completion of a daily report card or a "communication book" to facilitate communication between the caregivers and the teachers may be suggested as an accommodation under a 504 plan. (See "Definitions of specific learning disorder and laws pertaining to learning disorders in the United States", section on 'Laws affecting the education of

students with disabilities' and "Children and youth with special health care needs", section on 'School-based services'.)

Social skills training — Deficits in social skills and problems with peers require direct targeting over the long-term [55]. Social skills deficits can be addressed through social skills groups or similar interventions (in or out of the school setting).

Psychotherapy interventions — Psychotherapy interventions are distinct from behavioral interventions. Psychotherapy interventions are directed toward the child (rather than the caregiver or environment) and designed to change the child's emotional status (eg, play therapy) or thought patterns (eg, cognitive-behavior therapy, cognitive therapy).

We generally suggest against psychotherapy interventions for children with ADHD unless they have coexisting conditions that require psychotherapy interventions (eg, depression, anxiety, social deficits). In randomized trials and systematic reviews, psychotherapy interventions have not been proven beneficial for the core symptoms of ADHD in children [18,42,56]. Gains achieved with psychotherapy interventions in the treatment setting usually do not transfer to other settings (eg, classroom or home).

However, psychotherapy interventions may be helpful in addressing coexisting conditions or skill deficits. Play-based interventions may improve social skills in children with ADHD [57,58]. Cognitive-behavioral therapy (CBT) may improve organizational/planning skills, cognitive function, and/or coexisting psychiatric problems in adolescents with ADHD and may be a helpful adjunct to medications [59-64].

UNPROVEN INTERVENTIONS

Physical activity — At least 60 minutes of moderate to vigorous activity per day is recommended for all children ≥6 years of age, not just those with ADHD [65]. Regular physical activity has been associated with improved cardiovascular health, psychosocial well-being, and cognitive performance. (See "Physical activity and strength training in children and adolescents: An overview", section on 'Physical activity'.)

We support this recommendation for children with ADHD. In systematic reviews and small open-label controlled trials with heterogeneous designs, a range of physical activities (eg, yoga, team sports, aerobic activity, guided walks) have been associated with improvement in the core symptoms of ADHD with little risk of harm [66-76]. Small trials also suggest that aerobic exercise improves neurocognitive function [66] and increases the effectiveness of stimulant medications [77]. In meta-analyses, physical activity was associated with improved cognitive function and psychological well-being [64,76]. In one of

the analyses, cognitive function improved with a mean effect size of 0.93 (95% CI 0.48-1.45) [64]. Additional studies are needed to determine which types, duration, intensity, and frequency of exercise are most effective.

Dietary interventions

Elimination diets — We generally do not suggest elimination diets for children with ADHD, but decisions regarding trials of dietary interventions for ADHD must be made on a case-by-case basis. Some experts suggest that a short (no more than five-week) trial of an elimination diet may be warranted for certain children (eg, those whose caregivers are concerned about the use of and potential side effects of pharmacologic agents and are motivated to adhere to the diet) [78-80]. If the decision is made to try an elimination diet, the diet should be supervised by the child's health care provider and a dietician to ensure adequate nutritional intake. If behavior improves during the elimination diet, restricted foods can be added back weekly, one component at a time, to identify problematic foods that should be excluded from a less restrictive permanent diet.

Clinical guidelines and practice parameters from the American Academy of Pediatrics [3], the American Academy of Allergy, Asthma & Immunology [88], and the United Kingdom's National Institute for Health and Care Excellence (NICE) [14] do not routinely recommend elimination diets for the treatment of ADHD. However, the NICE guidelines indicate that referral to a dietician may be warranted if perceived links between specific foods or beverages and behavior are corroborated with a food diary [14].

Essential fatty acid supplementation — We do not suggest essential fatty acid supplementation to improve core symptoms in children with ADHD. Some studies have noted decreased fatty acid concentrations in the serum of children with ADHD [89-93]. However, evidence that fatty acid supplementation improves core symptoms in children with ADHD is limited [86,94-98]. Meta-analyses of randomized trials have conflicting results [18,42,94,96,98], and clear evidence of benefit is lacking [99]. Fatty acid supplementation is unlikely to be harmful.

Trigeminal nerve stimulation — We do not suggest trigeminal nerve stimulation (TNS) for the treatment of ADHD in children. Clinical experience is limited [107,108].

TNS is a noninvasive neuromodulation technique based on the hypothesis that electrical stimulation of the trigeminal nerve (supraorbital branch) affects the areas of the brain thought to be involved in ADHD [109,110].

Although a randomized trial found that TNS improved scores on ADHD-IV Rating Scales and Clinical Global Impression scales over four weeks, only 62 children were included [107]. No clinically important

adverse effects were reported. Additional studies are necessary to confirm efficacy and safety, and to determine which of children with ADHD are most likely to benefit as well as the optimal regimen [110].

Other alternative therapies — Complementary and alternative medicine (CAM) therapies may be considered or employed by as many as 64 percent of patients with ADHD [111]. CAM therapies often are used by patients without the explicit knowledge of the primary care provider [112-114]. It is important for primary care providers to ask their patients whether they have tried any CAM therapies for ADHD so that the risks and benefits of such therapies can be discussed [115].

CAM therapies other than physical activity, elimination diets, fatty acid supplementation, and mindfulness that have been suggested in the management of ADHD include vision training, megavitamins, herbal and mineral supplements (eg, St. John's wort), neurofeedback/biofeedback, chelation, and applied kinesiology, among others. Most of these interventions have not been proven efficacious in high-quality randomized controlled trials [42,64,116-128]. We do not routinely suggest these interventions for children with ADHD. (See "Clinical use of St. John's wort", section on 'Other conditions'.)

Several alternative therapies, including chelation and megavitamins, may have serious adverse effects or harmful interactions with other herbs, vitamins, supplements, and prescribed medications [3,129-131]. Additional harms include the potential failure and setback for the child when symptoms and problems persist, as well as unnecessary expenses, time cost, and opportunity cost when evidence-based ADHD treatments are delayed [116].

Clinicians can help caregivers who choose to explore CAM therapies to make thoughtful choices by [6,132]:

●Reviewing the stated goals or effects for a given treatment

●Reviewing the evidence of benefits and potential adverse effects, including drug-supplement interactions

●Encouraging caregivers who want to try CAM therapies to try them one at a time and to monitor target goals and core symptoms to determine effect

●Encouraging caregivers to determine a time frame in which they expect behavior changes to occur

●Encouraging caregivers to use evidence-based behavioral interventions and/or medications at the same time that they are exploring CAM therapies

The clinician also can try to redirect patients and caregivers who are using potentially harmful CAM therapies (eg, megavitamins) to safer (if still unproven) lifestyle therapies (eg, yoga, massage therapy). (See "Complementary and integrative health in pediatrics", section on 'Discussing complementary therapies with patients and families'.)

PROGNOSIS

Most of the information about prognosis in children with ADHD is derived from small cohort studies of male patients who were evaluated and treated for ADHD in psychiatric clinics [114,133-140]. The generalizability of the information to other patient groups is limited. Long-term follow-up (six to eight years) of the Multimodal Treatment study of children with ADHD (MTA) study cohort suggests that functioning during adolescence is predicted by the initial clinical presentation (including severity of symptoms and comorbid conduct problems), intellect, social advantage, and the strength of ADHD response to any mode of treatment [141]. Follow-up into early adulthood (approximately 16 years after enrollment at a mean age of approximately 25 years) suggests that functioning in early adulthood is predicted by persistence of symptoms, baseline ADHD severity, intelligence quotient, and comorbidity [142,143], and that most children have a course with intermittent periods of remission and recurrence [144]. Early and effective management and support may be helpful in improving adult outcomes.

●Persistence of symptoms – For most children with ADHD, ADHD symptoms fluctuate between childhood and young adulthood with intermittent periods of remission and recurrence. In prospective follow-up, 558 participants in the Multimodal Treatment Study of ADHD had eight assessments over time ranging from 2 to 16 years after baseline [144]. At the study endpoint (mean age of 25.1 years), 64 percent had fluctuating periods of remission and recurrence (full or partial), 16 percent had sustained partial remission, 9 percent had sustained remission, and 11 percent had persistent ADHD (met ADHD criteria at all follow-ups). At any given follow-up, 40 to 50 percent of participants met ADHD criteria, consistent with findings from earlier studies [145-150]. Factors associated with persistence of symptoms into adulthood include the severity of initial symptoms, coexisting mental health disorders, and parental mental health disorders [151,152]. (See "Attention deficit hyperactivity disorder in adults: Epidemiology, clinical features, assessment, and diagnosis".)

In another prospective study, 70 percent of 88 children diagnosed with ADHD at a tertiary care clinic before age seven continued to meet criteria for ADHD four to nine years later (median interval seven years) [19]. Among the 26 children who no longer met criteria for ADHD, new diagnoses included autism spectrum disorder (10 children), learning disorder (3 children), and anxiety disorder (2 children),

highlighting the importance of monitoring young children diagnosed with ADHD for symptoms of other neurodevelopmental and behavioral disorders. (See 'Preschool children' above.)

●Injury and self-injury – Children with ADHD or symptoms of ADHD are at greater risk for incurring intentional and unintentional injury than children without these symptoms [145,150,153-159].

•In a review of medical, pharmaceutical, and disability claims for injuries or poisoning treatments, individuals with ADHD were more likely to have at least one claim related to unintentional injury than controls (28 versus 19 percent for children, 32 versus 23 percent for adolescents, and 38 versus 18 percent for adults) [153].

•In nationwide cohort studies, ADHD was independently associated with increased mortality in children, adolescents, and adults [158,160]; most of the deaths were caused by unnatural causes, particularly unintentional injuries.

•In a prospective study of 140 females with ADHD diagnosed at age 6 to 12 years (93 with combined type [ADHD-C], 47 with inattentive type [ADHD-I]), those with ADHD-C were more likely to have attempted suicide during the 10-year follow-up than those with ADHD-I or controls (22, 8, and 6 percent, respectively) [150]. Self-injury was also more common among females with ADHD-C than females with ADHD-I or controls (51, 29, and 19 percent, respectively).

Treatment with stimulant medications may mitigate this risk [161-165]. In a study analyzing data from the Swedish national registers that included nearly 93,000 individuals (age 6 to 24 years) with ADHD, initiation of ADHD pharmacotherapy within three months of diagnosis versus non-initiation was associated with a reduction in two-year mortality risk from all-causes (13.5 versus 18.1 per 10,000 individuals, adjusted hazard ratio [aHR] 0.74, 95% CI 0.59-0.92), unnatural causes such as suicide, accidental poisoning or injury (11.7 versus 15.1 per 10,000 individuals, aHR 0.76, 95% CI 0.60-0.96), and natural causes (1.8 versus 2.9 per 10,000 individuals, aHR 0.63, 95% CI 0.35-1.10), but the latter was not statistically significant [161]. The observational design does not account for unmeasured confounders such as lifestyle factors or social support that could have contributed to the results.

●Driving – Adolescents with ADHD are more likely than those without the disorder to have motor vehicle crashes (relative risk 1.9, 95% CI 1.4-2.5 in a meta-analysis of five observational studies) [166,167]. The risk is particularly increased in the first months after obtaining a driver's license and may be related to risky driving behaviors (eg, speeding, not wearing a seatbelt, alcohol and/or drug use) [168]. Adolescents with ADHD also are more likely to have their driving licenses suspended or revoked. In randomized trials, driving performance improves with stimulant medication [166,169-171].

●Education – Follow-up studies of children with ADHD into adolescence consistently indicate impaired academic functioning (eg, completion of less schooling, lower achievement scores, failure of more courses) compared with controls [63,113,114,133,149,150,172-176]. This is particularly true for children with the inattentive or combined presentation of ADHD [177]. In the few studies in which subjects were followed into adulthood, the findings persisted (25 to 33 percent of probands versus 1 to 9 percent of controls dropped out of high school; 15 to 19 percent of probands versus 50 to 64 percent of controls had completed a bachelor's or higher level degree) [133,136,137,140,178]. Impaired academic function appears to persist, even in those children who no longer meet criteria for diagnosis of ADHD in adolescence or adulthood [114].

●Substance use – Children with ADHD may be at increased risk of engaging in substance use during adolescence and adulthood, particularly if they present with comorbid conduct disorder (CD) or oppositional defiant disorder (ODD). (See "Substance use disorder in adolescents: Epidemiology, clinical features, assessment, and diagnosis", section on 'Risk factors'.)

Although individual longitudinal studies have had inconsistent results, a 2011 systematic review and meta-analysis of 27 prospective longitudinal studies found that compared with children without ADHD, children with ADHD were at increased risk for [179]:

•Ever using nicotine (odd ratio [OR] 2.1, 95% CI 1.7-2.6) and nicotine dependence in adolescence or adulthood (OR 2.8, 95% CI 2.4-3.3)

•Alcohol use disorder (OR 1.7, 95% CI 1.4-2.2), but not ever use of alcohol

•Ever using marijuana (OR 2.8, 95% CI 1.6-4.7) and marijuana use disorder (OR 2.3, 95% CI 1.3-4.0)

•Cocaine use disorder (OR 2.1, 95% CI 1.4-3.0)

•General illicit drug use (substances not explicitly specified, OR 2.6, 95% CI 1.8-3.9)

The effect sizes did not differ by average age at follow-up, sex, race, population (eg, general versus referral), or diagnostic criteria for ADHD. However, the majority of these studies did not assess comorbid ODD or CD and, based on 10 studies, children with comorbid ADHD and ODD or CD had more substance

abuse problems than children with only ADHD and controls [179]. In fact, 2 of these 10 studies report no increased risk for substance abuse in ADHD beyond that explained by comorbid ODD and CD.

The mechanism for the association between ADHD and substance use is not clear [180]. Proposed theories include impulsivity, poor judgment, and biologic vulnerability (perhaps related to dopamine transmission).

The risk of engaging in substance use in adolescence or adulthood does not appear to be affected by the pharmacologic treatment of ADHD [181,182]. In a 2013 meta-analysis of 15 longitudinal studies (2565 participants), stimulant treatment neither protected against nor increased the risk of subsequent substance use disorders [182]. These findings differ from those of a 2003 meta-analysis of six studies, which found a reduced risk of substance abuse disorders among individuals with ADHD who were treated with medications compared with those who were not [183]. Additional support for a lack of effect is provided by eight-year follow-up of participants in the MTA (not included in the meta-analyses), in which children (7 to 9.9 years old at the time of enrollment) were randomly assigned to 14 months of medication, behavior therapy, combined medication and behavioral therapy, or standard community care [181]. No effect of medication for ADHD on subsequent substance use was found – whether analyzed by original treatment group, medication at follow-up, or cumulative stimulant therapy.

The lack of association between stimulant use and risk of subsequent substance use may not hold for youth who misuse prescription stimulants. A 2023 national longitudinal study of more than 5000 adolescents enrolled in 12th grade and followed for six years evaluated the association between stimulant use and subsequent cocaine or methamphetamine use [184]. Participants who used stimulants as prescribed for ADHD therapy at study entry were no more likely to start using cocaine or methamphetamine over the six-year follow-up period than participants who did not use stimulants. However, those who reported prescription stimulant misuse but no history of stimulant treatment for ADHD at study entry were more likely to have initiated cocaine or methamphetamine use compared with those who did not use stimulants at all (OR 2.6, 95% CI 1.5-4.6).

●Employment – In studies that followed children with ADHD into early adulthood, the rate of employment of ADHD probands did not differ from that of controls [136,137]. However, in a prospective male cohort that was followed for 33 years (mean age 41 years), fewer probands than controls were employed (83 versus 95 percent) [140]. Probands were reported to have lower status jobs and to perform poorly compared with controls when rated by their employers in various areas of work performance [133,140].

●Antisocial personality – Children who have ADHD are at increased risk to develop antisocial personality disorder (ASPD) and behaviors in adulthood [133,140,185]. In studies that followed children with ADHD

into adulthood, the prevalence of ASPD ranges from 12 to 23 percent in probands (predominantly with the hyperactive-impulsive presentation of ADHD) versus 2 to 3 percent in controls [134,136,137,140].

The increased risk of developing ASPD appears to be independent of comorbid conduct disorder in childhood because children with comorbid problems were excluded from several study cohorts [135,136]. In an observational study, 54 percent of 147 ADHD patients self-reported having been arrested at least once by age 21 years (compared with 37 percent of 73 community controls); 24 percent of ADHD patients had been arrested for misdemeanors (compared with 11 percent of controls) and 27 percent for felony (compared with 11 percent of controls) [185].

Information for teachers of children with ADHD is available through Children and Adults with Attention-Deficit/Hyperactivity Disorder.

SUMMARY AND RECOMMENDATIONS

●General principles

•Attention deficit hyperactivity disorder (ADHD) is a chronic condition; education of patients, caregivers, and teachers regarding the diagnosis is an integral part of treatment. Management centers on the achievement of target outcomes, which are chosen in collaboration with the child, caregivers, and school personnel. Coexisting conditions must be treated concurrently with ADHD. (See 'General principles' above.)

•Treatment of ADHD may involve psychosocial interventions, medication, and/or educational interventions, alone or in combination. Decisions regarding the choice of therapy should involve the patient and their caregivers. (See 'Involvement of patient and caregivers' above.)

•ADHD in children 4 to 18 years of age without comorbid conditions can usually be managed by the primary care provider. Indications for referral to or consultation with a specialist (eg, developmental behavioral pediatrician, child neurologist, psychopharmacologist, child psychiatrist, clinical child psychologist) may include (see 'Indications for referral' above):

-Coexisting psychiatric conditions (eg, oppositional defiant disorder, conduct disorder, substance abuse, emotional problems)

-Coexisting neurologic or medical conditions (eg, seizures, tics, autism spectrum disorder, sleep disorder)

-Lack of response to a controlled trial of stimulant therapy or atomoxetine

-Complex psychosocial context

●Management approach

•Preschool children – For preschool children (age 4 through 5 years) who meet the diagnostic criteria for ADHD, we recommend parent (or caregiver) training in behavior management (PTBM) rather than medication as the initial therapy (Grade 1A). For those who fail to respond to behavioral interventions alone, we suggest medications as an adjunct to behavioral interventions (Grade 2B). However, the values and preferences of the caregiver are critical factors in deciding whether to initiate medication. When medication is necessary for preschool children, we suggest methylphenidate rather than amphetamines or nonstimulants (Grade 2B). (See 'Preschool children' above and 'Pharmacotherapy' above and "Attention deficit hyperactivity disorder in children and adolescents: Treatment with medications", section on 'Preschool children'.)

•School-aged children and adolescents – For most school-aged children (≥6 years) and adolescents with ADHD who meet specific criteria (table 3), we suggest pharmacotherapy rather than behavior therapy alone or no intervention (Grade 2A). However, decisions regarding the choice of therapy should involve the patient and their caregivers. When the decision is made to try medications, we suggest a stimulant as the first line agent (Grade 2B). (See 'School-age children' above and 'Pharmacotherapy' above and "Attention deficit hyperactivity disorder in children and adolescents: Treatment with medications", section on 'Choice of agent'.)

For school-aged children (≥6 years) and adolescents with ADHD, we suggest that psychosocial interventions be added to medication therapy (Grade 2C). Adding psychosocial interventions to stimulant therapy in school-aged children and adolescents does not provide additional benefit for core symptoms of ADHD, but may affect symptoms of coexisting conditions (eg, oppositional/aggressive behavior) and lower the dose of stimulant therapy necessary to achieve the desired effects. (See 'Combination therapy' above.)

●Monitoring – Children being treated for ADHD should be monitored regularly for adherence to the treatment plan, achievement of target goals, occurrence of core symptoms, and adverse effects of therapy. The frequency of follow-up depends upon the management strategy. (See 'Monitoring' above.)

●School-based interventions – Children with ADHD may require changes in their educational programming, including tutoring, resource room support (either in an exclusive setting or within the classroom), classroom modifications, or direct skills training for adolescents. (See 'School-based interventions' above.)

●Dietary interventions – We suggest not using elimination diets for most children with ADHD (Grade 2C). However, a short trial (no more than five weeks) of an elimination diet may be an option for children with ADHD whose caregivers are concerned about the use and potential side effects of pharmacologic agents and are motivated to comply with the diet. (See 'Elimination diets' above.)

We suggest not using essential fatty acid supplementation for children with ADHD (Grade 2C). (See 'Essential fatty acid supplementation' above.)

●Prognosis – For most children with ADHD, ADHD symptoms fluctuate between childhood and young adulthood with intermittent periods of remission and recurrence. ADHD diagnosed in childhood is associated with increased rates of intentional and unintentional injury, substance use (particularly in those with comorbid oppositional defiant disorder or conduct disorder), and motor vehicle crashes among those who drive. (See 'Prognosis' above.)