Attention-Deficit/Hyperactivity Disorder in Children: Assessment, Management, and Outcome

Case Study and Commentary, *Christina G. Weston, MD*

Abstract

- *Objective:* To review the diagnosis and treatment of attention-deficit/hyperactivity disorder (ADHD) in children.
- *Methods:* Qualitative assessment of the literature.
- *Results:* ADHD in children is characterized by difficulty with attention to complex tasks, hyperactivity, and impulsivity. These symptoms result in impaired academic, occupational, and social functioning. Information from the child's school is required to make the diagnosis. Treatment modalities include patient and family education, pharmacologic therapy, and behavioral therapy.
- *Conclusion:* It is important for primary care physicians to identify patients with ADHD and ensure that they receive effective treatment.

INSTRUCTIONS

JCOM CME The following article, "Attention-Deficit/Hyperactivity Disorder in Children: Assessment, Management, and Outcome," is a continuing medical education (CME) article. To earn credit, read the article and complete the CME evaluation on pages 252 and 253.

OBJECTIVES

JCOM CME After participating in the continuing education activity, primary care physicians should be able to:

1. Recognize the presenting symptoms of attention-deficit/hyperactivity disorder (ADHD) in children
2. Know the diagnostic criteria for ADHD and its course into adulthood
3. Be familiar with typical comorbid psychiatric pathology
4. Be familiar with the pharmacology of agents used in the treatment of ADHD and evidence-based recommendations for pharmacologic treatment
5. Be familiar with psychosocial interventions used in the treatment of ADHD

Attention-deficit/hyperactivity disorder (ADHD) is a common chronic disorder in children. Prevalence estimates vary, but it may occur in 10% of boys and 5% of girls of elementary school age [1]. While once believed to occur in childhood and resolve during puberty, it is estimated that 60% of patients with childhood ADHD continue to have significant symptoms into adulthood [2]. ADHD is characterized by pronounced difficulty in maintaining focused attention on tasks, hyperactivity, and impulsivity. Parents often focus on the difficulty children with ADHD have in acquiring academic skills; however, these children also have significant difficulties in social and family interactions. Children with ADHD are more likely to abuse substances and engage in delinquent behaviors [3,4]. Adult outcomes of ADHD include lower educational and career attainment [5].

The exact etiology of ADHD is unknown, but it is thought to be caused by a combination of environmental, genetic, and biologic factors. ADHD is known to run in families; between 10% and 35% of children with ADHD have a first-degree relative with past or present ADHD. Higher rates of ADHD have been found in children with exposure to cigarettes and alcohol in utero, low birth weight, exposure to lead, and brain injuries occurring in utero [6–9]. Several genes regulating dopamine, norepinephrine, and epinephrine have been associated with ADHD. The most widely confirmed gene association has been found to be the DRD4 gene defect, found in 30% of the general population and 50% to 60% of the population with ADHD [10]. This defect creates a delay in translating dopamine signals. Both epinephrine and norepinephrine are agonists at DRD4, which explains how medications that affect either of these catacholemines can affect the dopamine system and improve ADHD symptoms [11]. The "dopamine hypothesis" proposes that inadequate availability of

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dopamine in the central nervous system contributes to ADHD. The neurotransmitter dopamine is important in initiating purposeful movement, increasing motivation and alertness, reducing appetite, and inducing insomnia. Stimulants increase the availability of neurotransmitter dopamine [12].

ADHD is one of the most common psychiatric disorders of childhood and adolescence. Given its high prevalence in school-age children, it is likely that primary care physicians will see these children often. It is important for primary care physicians to be able to identify patients with ADHD and to be comfortable with diagnosing and managing the disorder [13,14]. Given the chronic nature of the illness and estimates of its frequent persistence into adulthood, clinicians will need to manage the treatment of these children for many years.

CASE STUDY

Initial Presentation

A 7-year-old first-grade boy is brought to the family physician's office by his mother. She reports that she is worried about her son's behavior and that he doesn't listen to her.

History

The patient has been cared for by his physician since birth. His mother had an uncomplicated pregnancy, and he was born full term without any birth complications. His mother did not drink alcohol or use illicit drugs while pregnant but did smoke cigarettes. The patient achieved developmental milestones at appropriate times. He has been treated only for infections and for occasional accidents. He required stitches on one occasion after jumping off furniture and cutting his chin on a coffee table. During prior visits with the physician, the patient was noted to be very active, often attempting to dismantle the wall-mounted otoscope. The mother reports that her only child has always been "a handful." He was expelled from his first preschool at age 3 years because he was disruptive, wouldn't sit still for circle time, and would on occasion hit teachers or students when he didn't get his way. His mother delayed his starting kindergarten until he was 6 to give him time to mature. His kindergarten teacher noted last year that he couldn't follow directions well, had a short attention span, and was very active. His current first-grade teacher reports difficulties in getting him to sit down to read. His mother states that he will not stay focused on any activity except his Game Boy for more than 15 minutes. He is frequently loud and destructive when he plays.

There is a family history of depression in the maternal grandmother, and the patient's father is reported to have had been a "wild boy" when he was younger but was never treated for any mental health problems. The patient is on no prescription medications.

Physical Examination

On physical examination the patient appears to be a well-developed child. Multiple small bruises on his shins are noted. He is in the 55th percentile for both height and weight. He would not cooperate with otoscopic examination. The remainder of the physical examination including neurologic examination is unremarkable, and vital signs are within normal limits.

On mental status examination, the patient is a cheerful young boy. He spends most of the time climbing on and off the exam table and exploring items throughout the room briefly. Attempts by his mother to get him to read a book or sit in her lap are unsuccessful. His speech is somewhat loud and fast. Mood is described as "good." Affect appears happy, although he is somewhat labile when his mother scolds him for playing with the sink.

- **What is the differential diagnosis of behavior and attention problems in a young child?**

Several mental disorders are associated with behavioral problems in young children, with ADHD being the most common. There are other psychiatric disorders with symptoms that can be similar to ADHD, but these disorders have other symptoms unique to the particular disorder. The defiance and refusal to follow adult requests seen in oppositional defiant disorder (ODD) can be similar to not listening and impulsivity seen in ADHD. Severe aggression and inability to follow societal rules can be seen in conduct disorder and is in the differential for ADHD. Children who are depressed and/or anxious often are unable to pay close attention, and this can be confused with inattentive ADHD. Childhood bipolar disorder often presents with hyperactivity-impulsivity and inattention in addition to other symptoms not seen in ADHD.

Poor attention and behavior also may be caused by impaired vision or hearing, seizures, sequelae of head trauma, acute or chronic medical illness, poor nutrition, or insufficient sleep, and these causes need to be considered [1]. Learning disorders, mental retardation, and borderline intellectual functioning often can present with ADHD symptoms. These problems can be difficult to identify in children in the early school years. It is important to remember that some children with attention/behavioral problems may simply have a difficult temperament or an activity level that is at the high end of normal. Children with difficult temperament may have difficulties when in a poor school setting or have parents unable to effectively manage their behaviors; when these improve, their problems improve. A child with ADHD will still have difficulty with effective schools and parenting.

- **How can the diagnosis be confirmed?**

ADHD is a clinical diagnosis made on the basis of a comprehensive history of symptoms causing impairment in several settings. The DSM-IV-TR criteria for ADHD [13] are 6 or more symptoms of inattention and/or 6 or more symptoms of hyperactivity-impulsivity (**Table 1**). Symptoms must have persisted for at least 6 months and be maladaptive and inconsistent with a child's developmental level. The symptoms must have been present before the age of 7 and also be present in 2 or more settings. It is important to keep in mind the child's developmental level. A first-grader who is unable to sit and listen to a teacher's lecture for 30 minutes would not be considered abnormal, whereas a high school student's inability to listen to a lecture for 30 minutes would be considered developmentally inappropriate.

The assessment of ADHD in a school-aged child requires a careful interview with the family to document the presence of multiple symptoms of inattention and hyperactivity-impulsivity. This can be done by direct interview of the mother and/or having her complete an ADHD-specific rating scale. Information from the school also is required to document the degree of impairment in the classroom. It is helpful to have the teacher complete an ADHD-specific behavior checklist and to get narrative information from her about the child's classroom behavior, learning patterns, degree of functional impairment, and which classroom interventions are helpful.

Questioning of the Patient's Mother

Dr: What activities are hard for your son to do?
Mom: He will not stick with things that are hard. He'll play with his cars for 5 minutes then move onto his blocks, but he doesn't stick with the blocks long enough to build anything. If I stay and play with him one on one, I can usually get him to complete a project before he destroys it.
Dr: How do you manage these behaviors at home?
Mom: I watch him like a hawk. If I can keep him interested in his video games, I can usually get some housework done. When I don't watch him, something or someone usually gets damaged. I have to be extra careful around parking lots and busy streets. He's darted into traffic several times—so far we've been lucky and he hasn't been hit.
Dr: Have his behaviors made your family life difficult?
Mom: Absolutely. We still can't go to sit-down restaurants because he can't wait for his food. He is often under the table playing with our feet or is talking too loudly. We stopped going to church because he couldn't

Table 1. DSM-IV-TR Diagnostic Criteria for Attention-Deficit/Hyperactivity Disorder

A. Either (1) or (2):
   (1) 6 (or more) of the following symptoms of **inattention** have persisted for at least 6 months to a degree that it is maladaptive and inconsistent with developmental level:
      (a) often fails to give close attention to details or makes careless mistakes in schoolwork, work, or other activities
      (b) often has difficulty sustaining attention in tasks or play activities
      (c) often does not seem to listen when spoken to directly
      (d) often does not follow through on instructions and fails to finish schoolwork, chores, or duties in the workplace
      (e) often has difficulty organizing tasks and activities
      (f) often avoids, dislikes, or is reluctant to engage in tasks that require sustained mental effort (such as schoolwork or homework)
      (g) often loses things necessary for tasks or activities
      (h) is often easily distracted by extraneous stimuli
      (i) is often forgetful in daily activities
   (2) 6 (or more) of the following symptoms of **hyperactivity-impulsivity** have persisted for at least 6 months to a degree that is maladaptive and inconsistent with developmental level:
      Hyperactivity
      (a) often fidgets with hands or feet or squirms in seat
      (b) often leaves seat in classroom or in other situations in which remaining seated is expected
      (c) often runs about or climbs excessively in situations in which it is inappropriate (in adolescents or adults, may be linked to subjective feelings of restlessness)
      (d) often has difficulty playing or engaging in leisure activities quietly
      (e) is often "on the go" or often acts as if "driven by a motor"
      (f) often talks excessively
      Impulsivity
      (g) often blurts out answers before questions have been completed
      (h) often has difficulty awaiting turn
      (i) often interrupts or intrudes on others
B. Some hyperactive-impulsive or inattentive symptoms that caused impairment were present before age 7 years
C. Some impairment from the symptoms is present in 2 or more settings (eg, at school [or work] and at home)
D. There must be clear evidence of clinically significant impairment in social, academic, or occupational functioning
E. The symptoms do not occur exclusively during a course of a pervasive developmental disorder, schizophrenia, or other psychotic disorder and are not better accounted for by another mental disorder (eg, mood disorder, anxiety disorder, dissociative disorder, or a personality disorder)

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sit quietly. He completely refuses to do any chores. My older daughter has started questioning why she has to do all the chores around the house.

Dr: Will he refuse to do things you ask him to do often?

Mom: Sometimes I'll ask him to clean up his room and he'll go upstairs and I'll find him playing with his cars. I'll remind him and he'll start but soon get distracted. He'll often try to do what I ask—it just seems like he isn't listening or doesn't remember what I asked him to do.

Dr: Is he aggressive at home?

Mom: Not really. Sometimes he'll hit his sister if he wants a toy, but just as often she provokes him and he will hit her back.

Further Assessment

The physician asks the patient's mother to complete an ADHD symptom checklist and to have the boy's teacher complete one as well. The physician obtains written permission to talk with the patient's teacher about his difficulties in school. He meets with the boy alone. The patient admits that he is in trouble at home and school but is largely unaware of his role in his problems. The physician asks the mother to bring copies of her son's old report cards to the next appointment.

- **Which rating scale should be used?**

Many rating scales exist to evaluate psychiatric disorders in children. Two main types of rating scales exist. The first is the global nonspecific questionnaire, which is used to identify a variety of symptom clusters in children. The most commonly used scale in research and clinical settings is the Child Behavior Checklist (CBCL). This test generates a variety of symptom subscales and is available for several informants [15]. The wide scope of this scale makes it useful for identifying a differential diagnosis and disorders comorbid with ADHD. By itself it is not a very strong measure of ADHD symptoms and is not helpful for repeated administration to monitor treatment. For this reason, global scales are not recommended by the American Association of Pediatrics (AAP) for use in the diagnosis of ADHD because they lack specificity in distinguishing children with ADHD from children without it [16]. The AAP does recommend the use of ADHD-specific screening questionnaires. There are a variety of scales in clinical use (**Table 2**) [17]. When selecting a rating scale it is important to choose one that is easy to administer, has parent and teacher versions, has strong psychometric properties, and has a normative base. Rating scales are commonly used initially to aid in the diagnosis of ADHD and during follow-up to help monitor the patient's response to treatment. It is important to keep in mind that rating scales alone are not a basis for making a diagnosis of ADHD. It is possible for a parent or a teacher who strongly believes that a child does or does not have the disorder to be biased when completing the scale. They are, however, a useful tool in conjunction with a complete history and physical for making the diagnosis.

Follow-up

The physician speaks with the patient's teacher, who reports that he is very disruptive in class, much more so than his peers. He is unable to sit in his chair for longer than 10 minutes without getting up to move around the classroom. She feels that his hyperactivity and low attention span are making it difficult for him to acquire improved reading skills. She does report that statewide testing indicated that he was performing as expected for a first-grader.

The patient and his mother return in 2 weeks with the completed rating scales. On the scale, the teacher endorsed 7 of 9 inattentive symptoms and 8 of 9 hyperactive/impulsive symptoms. There were no indications of any significant mood or defiant symptoms. The scale showed significant academic impairment with difficulty maintaining focus to acquire new academic skills. The parent rating scale also showed multiple inattentive and hyperactive/impulsive symptoms as well as impairment in social and family functioning.

- **Why should the diagnosis of ADHD be considered in this patient?**

The description of this patient's symptoms by his parent and teacher are consistent with childhood ADHD. He has significant difficulty sustaining focused attention on classroom tasks as well as on play activities and chore completion at home. He also has multiple hyperactive and impulsive symptoms. The description of his symptoms appears out of the normal developmental expectation for a 7-year-old boy, and there is clear evidence of impairment in both the patient's ability to function as expected in school and in the home and social environments.

- **Is there a co-occurring psychiatric disorder in this patient?**

Up to two thirds of children with ADHD have a comorbid psychiatric disorder. The most common disorders are

Table 2. ADHD Rating Scales

Rating Scale (Ages)	Versions	Reliability and Validity Data	Comments	Reference (Publisher)
Connors Rating Scale-Revised (CRS-S) (3–17 yr)	Parent Teacher Adolescent self-report	Good to excellent	Evaluates several subscales: cognitive problems/inattention; hyperactivity, oppositional; anxious-shy; perfectionism; social problems; psychosomatic	Conners, 1997 (Multi-Health Systems)
IOWA Conners (6–12 yr)	Teacher Parent Adolescent	Moderate for teacher No data for parent or adolescent versions	Older scale; continues to be widely used Can overidentify minority youth Short administration time; good for multiple administrations	Pelham et al, 1989 (Loney & Milich)
SNAP-IV (5–11 yr)	Parent Teacher Short version: ADHD + ODD Full version: ADHD + symptoms from other disorders	No published psychometric properties and limited normative data	Used widely in research	Swanson, 1992 (www.ADHD.net)
SKAMP (7–12 yr)	Teacher	No published psychometric properties and limited normative data	Brief classroom rating scale (included in SNAP-IV) Very specific to ADHD	Wigal et al, 1998 (www.ADHD.net)
ADHD RS-IV (5–18 yr)	Teacher Parent	Very good to excellent	DSM-IV–based Short administration time Little normative data for preschoolers Suboptimal sensitivity and specificity	DuPaul et al, 1998 (Guilford Press)
Vanderbilt ADHD rating scale (VADRS) (6–12 yr)	Teacher Parent Full version: ADHD + symptoms from other disorders Short version: ADHD	Good to excellent	DSM-IV–based New scale–only limited normative data available	Wolraich, 2003 (www.nichq.org)
ADHD-SRS (4–18 yr)	Teacher Parent	Excellent	Long administration time Limited use for repeat administration Good for finding ADHD subtypes	Holland et al, 2001 (Wide Range)
ACTeRS (5–13 yr)	Teacher Parent Self-report	Excellent (teacher) Good (parent)	Older scale Unclear normative base Quick to administer and score	Ullman et al, 2000 (Metritech)
BADDS (3–18 yr)	3–12 yr: teacher & parent 8–12 yr: teacher, parent, & self-report 12–18 yr: self-report	Good to excellent	Designed to measure underlying executive functioning deficits Developmentally suitable forms	Brown, 2001 (Psychological Corp)

ODD = oppositional defiant disorder.

ODD (50% of ADHD patients), conduct disorder (30% to 50%), mood disorders (20% to 25%), and anxiety disorders (20% to 25%) [18,19]. Adolescents frequently develop substance abuse and dependence disorders. Learning disorders can be seen in 10% to 25% of children with ADHD, depending on the criteria used to identify the learning problem [20].

Bipolar disorder can be especially difficult to distinguish from ADHD in young children. Children with bipolar disorder usually have clear mood impairments, including elation, grandiosity, severe irritability and anger, a decreased need for sleep, hypersexuality, and racing thoughts [21]. Children with several disorders are more likely to be seen in

Table 3. ADHD Parent Resources

Online

www.add.org
Web site of the Attention Deficit Disorder Association, a national nonprofit organization

www.ncpamd.com
Site maintained by Northern Country Psychiatric Associates, a private psychiatric practice in Baltimore, MD

www.chadd.org
Web site of CHADD (Children and Adults with Attention-Deficit/Hyperactivity Disorder), a national nonprofit organization

www.nimh.nih.gov/publicat/adhd.cfm
Link to the National Institute of Mental Health patient booklet on ADHD

www.sandiegoadhd.com
Web site of San Diego Children's Hospital. Has good basic ADHD information.

Books

Barkley R. Taking charge of ADHD: The complete, authoritative guide for parents. New York: Guilford; 1995. *Comprehensive guidebook on ADHD written by a nationally recognized expert*

Clark L. The time-out solution: a parent's guide for handling everyday behavior problems. Chicago: Contemporary Books; 1989. *Lots of detail on time-out and other punishments as well as positive ways to increase appropriate behavior*

Ingersoll B, Goldstein S. Attention deficit disorder and learning disabilities: realities, myths, and controversial treatments. New York: Doubleday Main Street Books; 1993. *Review focusing on causes and treatment; has good coverage of common myths and unfounded claims*

a mental health center than be treated by primary care providers.

In this patient, the mother and teacher do not report any significant difficulty with defiance or aggression, which is commonly seen in ODD. The screening scales do not indicate any significant anxious or affective symptoms. There is a possibility that the patient also could have a learning disorder. It can be difficult to identify some learning disorders in children at this age. Since the patient is performing at his grade level, a learning disorder can be ruled out for now.

- **What are initial steps of clinical management?**

Family Education

Management of ADHD begins with educating the patient and family about the disorder. Without an understanding of the disorder, families can view a child's impulsivity and hyperactivity as misbehavior and become harsh and blaming in their discipline strategies. By helping families understand that some of the behaviors are not their child's fault, one can get them past blaming the child and on to helping. A number of Web sites and books are available to help families learn more about the illness (**Table 3**).

Education of families about ADHD should include an explanation of the symptoms of the disorder and how it can affect learning, behavior, social skills, and family function. Self-esteem can be decreased in ADHD children by the common poor school performance and frequent negative interactions with adults and peers caused by their impulsive behaviors. The etiology of the disorder including the heritability needs to be discussed. Various treatment options need to be reviewed, including medication effects as well as basic principles of behavior management. It is helpful to give families information about the expected course and prognostic features of the illness. Families also need information on how to advocate for their child in the school setting, work with teachers, and what their child's legal rights are within the public school system.

Families may hold misconceptions about ADHD, and it is important to dispel them. ADHD does not stop at puberty, nor do the medications stop working then. Stimulant medications do not cause drug abuse and do not work paradoxically [1]. Families frequently believe that sugar makes a child more hyperactive; however, studies have failed to show that this is the case [22].

Generating the Treatment Plan

Once the patient and family have a more complete understanding of ADHD, it is important to identify areas of dysfunction in need of improvement. A treatment plan can be generated to improve multiple areas. Once problem areas are identified, a comprehensive treatment plan can be developed with the family. Examples of target outcomes are

- Improved relationships with parents, siblings, and peers
- Improved academic performance
- More independence in self-care or homework completion
- Decrease in disruptive behaviors
- Increase in self-esteem
- Decrease in unsafe community behaviors, for example, running into traffic while crossing the street or riding a bicycle [23]

Medication Management

Stimulants

Stimulants, first shown to be effective in treating disruptive behavior in 1937 [24], have been used safely in children for many years and are the first-line agents for treating ADHD. Numerous studies have shown them to be effective in significantly improving ADHD symptoms [1,25].

The Multimodal Treatment Study (MTA) study followed 579 children over 14 months and showed that medication management was superior to behavioral treatment alone and to community treatment in reducing ADHD symptoms [25]. The MTA was a landmark study when it was released in 1998 because it was the first large long-term study showing that improvement in ADHD symptoms continues over a long period. It divided children into 3 groups: medication management only, combined medication management and behavioral therapy, and behavioral therapy alone. The control group in the study received community treatment, and many of those children were on stimulant medication. The study found that there was little improvement gained by behavioral treatment, and it also showed that current community treatments were not aggressive enough to make significant improvements in ADHD symptoms. The medication group had higher doses of stimulants (38 mg versus 22 mg of methylphenidate) and more frequent doses (3 times daily versus twice daily) than the community treatment group [26]. The study also highlighted the difficulty in completely eliminating ADHD symptoms. Only 38% of the medically managed children in the study had ADHD symptom scores in the normal range at the end of the study [27].

There are 2 main classes of stimulant medications: methylphenidate-based (Ritalin) and dextroamphetamine-based (Dexedrine and Adderall). Stimulants work by blocking dopamine transportation in the striatal areas of the brain. This blockade increases the level of dopamine at the synapse and reduces the behavioral problems seen in ADHD [28]. Stimulant side effects include decreased appetite, abdominal pain, insomnia, headache, and tics. More rarely they may cause an aggravation reaction (paradoxical worsening of symptoms), hypertension, weight loss, emotional lability, nervousness, or depression. No serious consequences of prolonged use have been found. Often the consequences of not adequately treating ADHD are far worse than any potential side effects. Side effects are often mild and are usually transient; when problematic, they can be managed by dose reduction or switching to a different agent. Weight loss can frequently be managed by encouraging parents to increase caloric intake and rarely by stopping medication over the summer to allow for weight gain.

Parents frequently worry that long-term stimulant use will cause growth suppression in their children. Several studies have found that children treated with stimulants for long periods attained adult heights statistically equivalent to those of control groups [29–31]. In addition, there is often concern that since stimulants are controlled substances with some abuse potential that using them to treat ADHD will cause children to have substance abuse problems later in life. A recent meta-analysis showed that children who were treated with stimulants for ADHD had a lower risk of developing subsequent drug and alcohol use disorders than children with ADHD who did not receive stimulant medication [32].

Pemoline (Cylert) is a stimulant medication that is not frequently used because it has been associated with liver failure and death in rare cases and requires monitoring of liver function every 2 weeks [33].

Atomoxetine

Atomoxetine (Strattera), a selective norepinephrine reuptake inhibitor, is the first nonstimulant medication approved by the U.S. Food and Drug Administration for ADHD treatment. It has some advantages over the stimulants: It provides coverage throughout the day and is not a schedule II drug, making prescribing easier. It has been found in studies to be better than placebo in decreasing symptoms of ADHD and improving family and social functioning in school-age children [34,35]. It does not have stimulant side effects but is associated with gastrointestinal side effects and sedation that can make it difficult to tolerate. In clinical practice the improvement in ADHD symptoms does not appear to be as robust as that seen with stimulants [36]. It can be considered a first-line agent for those patients who object to or cannot tolerate stimulant medications; however, stimulants should remain the first medication choice for most patients.

Antidepressants

Several antidepressant medications often are used to treat ADHD when stimulants cannot be tolerated or alone are not effective in relieving symptoms. Buproprion (Wellbutrin and Wellbutrin SR), a dopamine and norepinephrine reuptake inhibitor, has been shown in controlled studies to be an effective treatment for ADHD [37]. A small double-blind comparison study of buproprion and methylphenidate showed that both drugs produced significant improvement on ADHD symptom scales [38]. Since buproprion is generally well tolerated, it is often used as a second-line agent or added to stimulant medications to improve response. Wellbutrin and all other newer antidepressants have recently been given FDA warnings for possible suicide risk in children and adults. Tricyclic antidepressants also have been shown to be effective in treating ADHD in many studies [39]. However, tricyclic antidepressants frequently are associated with adverse events, including several reports of sudden death with desipramine treatment. Imipramine and nortriptyline are somewhat better tolerated than the other tricyclics and

Table 4. Pharmacologic Agents for Treatment of ADHD

Generic Name	Trade Name	Formulations	Recommended Dose	Duration of Action
First-line medications				
Methylphenidate				
Short duration	Ritalin Methylin	5-, 10-, 20-mg tab 5-, 10-, 20-mg tab	Initial: 5 mg bid (AM and noon) Max: 60 mg/d	3–5 hr
	Focalin	2.5-, 5-, 10-mg tab	Initial: 2.5 mg bid (AM and noon) Max: 20 mg/d	
Intermediate duration	Ritalin SR Metadate ER Methylin ER	20-mg tab 10-, 20-mg tab 10-, 20-mg tab	20–40 mg po qd or bid equivalent to prior short-acting dose	3–8 hr
Long duration	Concerta Metadate CD Ritalin LA	18-, 27-, 36-, 54-mg tab 20-mg cap (6 mg IR, 14 mg ER) 20-, 30-, 40-mg cap (1/2 IR, 1/2 ER)	1 q AM, max 72 mg/d 1 q AM, max 60 mg/d 1 q AM, max 60 mg/d	12 hr 8 hr 8 hr
Amphetamine/ dextroamphetamine				
Short duration	Dexedrine Dextrostat	5-mg tab 5-, 10-mg tab	5 mg bid–tid, max 40 mg/d	4–6 hr
Intermediate duration	Spansule Adderall	5-, 10-, 15-mg cap 5- 7.5-, 10-, 12.5-, 15-, 20-, 30-mg tab	5–10 mg qd– bid, max 40 mg/d 5–10 mg qd– bid, max 40 mg/d	6–8 hr
Long duration	Adderall XR	5-, 10-, 15-, 20-, 25-, 30-mg cap	10 mg qd, max 30 mg po qd	10–12 hr
Atomoxetine	Strattera	10-, 18-, 25-, 40-, 60-mg cap	Initial: 0.5 mg/kg q AM or bid, increase after 3 days to 1.2 mg/kg q AM or bid Max: 1.4 mg/kg/d or 100 mg/d	24+ hr
Second-line medications (refer to psychiatric specialist)				
Buproprion	Wellbutrin Wellbutrin SR Wellbutrin XL	75- and 100-mg tab 100- and 150-mg tab 150- and 300-mg cap	100–150 mg qd–tid 100–200 mg qd–bid 150–450 mg qd	6–8 hr 12 hr 24 hr

ER = extended release; IR = immediate release.

occasionally are used as second-line agents. A summary of medications used to treat ADHD is found in **Table 4**.

When prescribing stimulant medication to children, begin with a low dose and titrate up until the optimal dose is found. The best dose is one with maximal improvement and fewest side effects. Families commonly think that they only need the medication on school days. If the child has significant impairment in social and family functioning, then they will need dosing on weekends and holidays. This often needs to be specifically discussed with families. If a child does not respond to one stimulant medication, then the other type should be tried. See the **Figure** for a medication treatment algorithim [23].

Behavioral Treatment

Behavior therapy involves assessing problematic responses and modifying the physical and social environment to change a child's behavior. There are a variety of interventions, and they usually are implemented by training parents and teachers specific techniques to improve behavior. Parent training in behavior therapy and classroom behavior interventions have been found to be effective in successfully improving the behavior of children with ADHD [40]. Four main techniques are used. *Positive reinforcement* provides rewards or privileges contingent on a child's performance. *Time-out* involves removing access to a positive reinforcement contingent on a child exhibiting unwanted behavior. *Response cost* involves withdrawing privileges or rewards contingent on the performance of problem behavior. A t*oken economy* can be implemented, which combines positive reinforcement and response cost. The child earns rewards and privileges if he performs desired behaviors and loses rewards and privileges if he shows undesirable behavior [41].

Treatment in This Patient

The patient was prescribed a long-acting stimulant medication at the low initial dose to be taken once each morning. Over several monthly visits, with follow-up

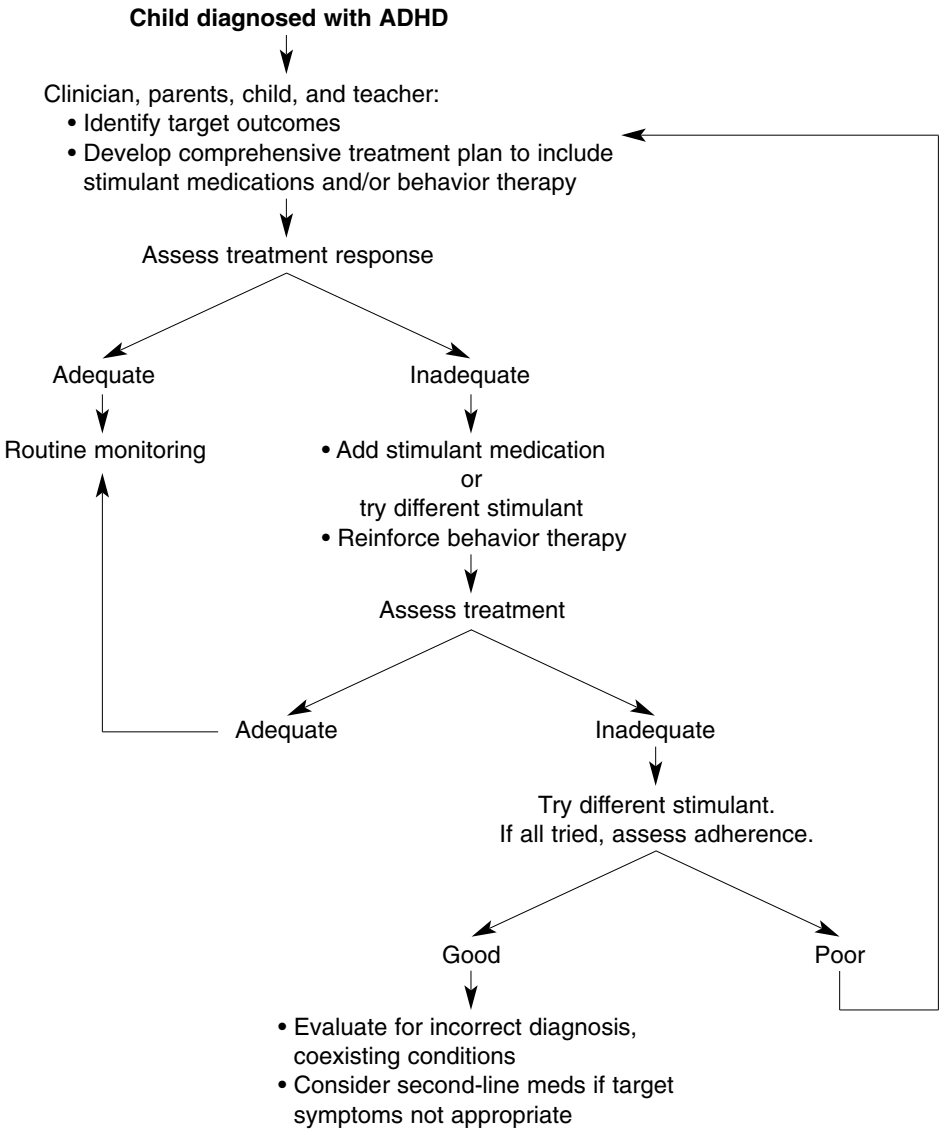

Figure. Algorithm for the treatment of the school-aged child with ADHD. (Adapted with permission from American Academy of Pediatrics. Subcommittee on Attention-Deficit/Hyperactivity Disorder and Committee on Quality Improvement. Clinical practice guideline: treatment of the school-aged child with attention-deficit/hyperactivity disorder. Pediatrics 2001;108:1035. Copyright © 2001.)

teacher and parent rating scales completed on alternating months, his dose was increased and was one dose below the maximum dose after 4 months. Once the patient was at the optimal dosage, both parents and teacher reported minimal difficulty with attention and hyperactivity. He had some appetite suppression initially that resolved without any intervention other than to encourage eating at mealtimes. Over several months of follow-up, he began to gain weight and height as expected on his growth curve. The family was able to advocate for educational interventions within the school system, and the patient was placed on an individualized education plan. They found that several of the ADHD Web sites offered helpful advice for handling problem behaviors.

After 3 years of treatment and occasional dose increases, the family found that the patient's aggression with friends and refusal to comply with parental requests were problematic. They were referred to a mental health professional, and the parents received training in dealing with the behavioral difficulties posed by ADHD while the patient participated in an ADHD social skills group. The parents determined that

they had been too lenient in their discipline strategies and began to employ the behavioral therapy techniques, which helped reduce their child's defiant behaviors. The patient found that the social skills training helped him to get along better with his peers, and he continued to be a successful student and developed more meaningful peer relationships.

SUMMARY

ADHD is a common childhood psychiatric disorder that often persists into adulthood. It affects not only children's academic success but their social and family functioning as well. Diagnosis of ADHD can be done in the primary care clinician's office with input from family and teachers. When properly diagnosed, medication and behavioral treatments can provide a significant improvement in a child's ability to function.

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