



Pearls, perils, and pitfalls in the assessment and treatment of attention-deficit/hyperactivity disorder in adolescents

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Purpose of review

To provide clinicians with an updated overview of key considerations related to the clinical assessment and management of attention-deficit/hyperactivity disorder (ADHD) in adolescents.

Recent findings

The American Psychiatric Association's recently revised Diagnostic and Statistical Manual of Mental Disorders-5 included significant changes regarding diagnostic criteria for ADHD in adolescents. The American Academy of Pediatrics (AAP) also recently revised their Clinical Practice Guidelines for ADHD; whereas prior guidelines were focused on children aged 6–12, the new guidelines extend up to age 17. An understanding of these revised diagnostic criteria and clinical guidelines is essential for pediatricians and others who care for adolescents. In addition to providing an updated review of the clinical approach to assessment and treatment of ADHD in adolescents, recent findings are briefly described relating to common comorbidities, psychosocial risks, and long-term outcome.

Summary

Diagnosis and treatment of adolescents with ADHD present unique challenges and obstacles. Clinicians need to be careful and deliberate in their evaluation of a teenager with recent-onset symptoms suggestive of ADHD, giving consideration to other conditions that could mimic ADHD and screening for common comorbid conditions. In terms of treatment of adolescents, the AAP recommends medication as the first-line intervention, noting that stimulants have a much broader evidence base and larger effect size than nonstimulants. Although clinicians now have a multitude of medication formulations to choose among, they must also be vigilant to the potential for stimulant misuse and diversion.

Keywords

attention-deficit/hyperactivity disorder, adolescents, substance use disorder

INTRODUCTION

Attention-deficit/hyperactivity disorder (ADHD) is a neurodevelopmental disorder typified by significant inattention and/or hyperactivity/impulsivity that interferes with function. The American Psychiatric Association (APA) recently revised its Diagnostic and Statistical Manual of Mental Disorders (DSM), and this new fifth edition (DSM-5) included some significant changes regarding diagnostic criteria for ADHD in older children [1^{••}]. Although ADHD is most commonly diagnosed during childhood, it is important to consider its impact on adolescent patients. Adolescents with ADHD vary considerably from their younger counterparts socially, physically, and emotionally, leading to differences in their diagnosis, treatment, and adherence. It is for these reasons that the American Academy of Pediatrics

(AAP) has recently extended their Clinical Practice Guidelines [2^{••}] for ADHD beyond the scope of just grade school and middle school children to include adolescents. The development of these new guidelines as well as the updated diagnostic criteria highlight the importance and timeliness of a review focusing on ADHD in adolescents.

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KEY POINTS

- Diagnostic criteria for ADHD in adolescents have been revised in the APA's DSM-5, now stipulating that symptom onset must be by age 12 (not 7).
- The American Academy of Pediatrics' revised clinical guidelines for assessment and management of ADHD have been substantially expanded to include teenagers.
- Although teenagers with the inattentive form of ADHD may not present until the teen years, clinicians need to carefully consider other reasons why a teen may be struggling academically because of inattention or distractibility.
- Medication, not behavior therapy, is the first-line treatment for teens with ADHD.
- Clinicians need to be mindful of the potential for misuse and diversion of stimulant medication when treating adolescents with ADHD.

PREVALENCE

The National Center for Health Statistics reported very recently that the prevalence rate of ADHD in children 5–17 has risen to 9%, with the diagnosis more common in men (12.3%) than women (5.5%) [3]. Three million children between 12 and 17 (12.2%) are estimated to have ADHD [4]. Although it is conceivable that the prevalence rates for ADHD will increase further now that the DSM-5 has extended the age threshold for symptom onset from 7 to 12 years of age [1[•]], further significant changes are unlikely as the DSM changes are in essence simply codifying how clinicians have been approaching the assessment of ADHD for many years. Longitudinal studies suggest that childhood diagnoses of ADHD persist into adolescence 75% of the time [5], and into adulthood 50% [6].

ASSESSMENT AND DIAGNOSIS

Many significant changes have been made to the diagnostic criteria for ADHD in DSM-5, much of which pertains to adolescents. From a nosological standpoint, the DSM still delineates three ADHD subtypes: predominantly inattentive, predominantly hyperactive/impulsive, and combined. The subtypes seen most often in adolescents are the inattentive and combined types.

Although the language of the criteria from DSM-IV has been retained, certain age-related changes have been made in DSM-5. For example, the age of onset of any ADHD symptoms has shifted from 7 to 12. Ideally, this later age should provide more time for observing pertinent diagnostic

evidence as well as reduce the prevalence of over-diagnosis. Additionally, research has demonstrated not only that adults with ADHD find it difficult to provide an accurate age of onset retrospectively but also that there are no significant differences found between children diagnosed by age 7 versus after that age [7,8].

Another major change is a reduction in the criteria threshold for diagnosis of patients 17 and older. These patients are only required to demonstrate five of the inattentive or hyperactive/impulsive symptoms, instead of the normally required six. Research has demonstrated that ADHD can be diagnosed in these older patients just as reliably with five symptoms [9]. The DSM-V now includes more examples of clinical descriptors which are age-appropriate for adolescents with ADHD. Examples include being distracted by unrelated thoughts and forgetting to return calls to describe inattention, and intruding into others' affairs to describe hyperactivity/impulsivity.

Many adolescent patients with ADHD are diagnosed early in childhood. Those who were overactive as preschoolers were most likely to be diagnosed with ADHD, predominantly hyperactive/impulsive subtype; however, their diagnosis will typically change with time, shifting to the combined subtype as these youngsters reach school age and symptoms of inattention also become evident and impairing. Such patients generally carry substantial ADHD-related impairments into adolescence, and thus are advised to continue treatment [1[•]].

Whereas ADHD is often recognized during the first decade of life, many children and adolescents may not present until later on – during their middle school or high school years. The fact that the DSM-5 has extended the age threshold for onset of symptoms to age 12 years emphasizes how important it is for clinicians to consider the inattentive subtype of ADHD in teens who are struggling in school. Unfortunately, making a diagnosis of ADHD is fraught with many potential pitfalls, and clinicians need to give full consideration to the many other diagnoses within the differential diagnosis and be mindful of the various comorbid conditions that can complicate treatment.

Challenges to new diagnoses

Multiple factors hinder the process of diagnosing ADHD in adolescents. For some adolescents, signs of inattention may have been present at an earlier age, but, because of having a high intelligence quotient or superior scholastic aptitude, they may not have performed poorly in an academic setting. In other

cases wherein academic struggles were evident, a student's ADHD symptoms may have been overlooked if their academic struggles were attributed to a comorbid learning disorder. Additionally, some youth with mild ADHD may have effective compensatory strategies for their attention-deficits in the classroom, and thus elude clinical evaluation during their grade school or middle school years. In high school, however, the academic challenges and organizational demands placed on students are often too great for these adolescents to continue to perform satisfactorily. Clinicians must take it upon themselves to identify such underachieving patients as early as possible.

Although pediatricians often rely upon parents to provide clinical information about a child's attention span and behavior in the home setting, parents may sometimes feel less qualified to play an informative role in reporting on the behavior of adolescents. Parents may have fewer opportunities to monitor their child's behavior during this time period because of the busy and somewhat independent nature of the adolescent lifestyle. When evaluating teenagers for ADHD, feedback from teachers can be even more inconsistent or unreliable. Unlike teachers in a grade school setting who spend most of the day with the same class of 20–25 children, teachers in a middle school or high school setting may be less capable of assessing a student's attention span as they may be responsible for teaching over 100 students each day, typically spending about 42 min daily with each class. Although many high school teachers take a great interest in all of their students, some secondary school teachers may be less concerned about or invested in why some of their students seem to be struggling or disinterested. Moreover, adolescents often have class schedules that vary or alternate on a recurring schedule. Thus, a student may have social studies, for example, in the morning when he is fresh and alert on some days and at the very end of the school day on other days. Thus, the same student may appear more alert and attentive on some days than others just because of the time of day – introducing an element of variability into the assessment process. Additional variability is introduced when one considers that students often have greater aptitude or interest for some subjects than others. If a student has a passion or knack for science, then it is possible that the science teacher will report there are no apparent attention problems even though feedback from the majority of the student's other teachers suggests otherwise. To obtain a fuller picture of the adolescent, it is sometimes helpful to seek input from other figures in the adolescent's daily activities, such as guidance counselors and

coaches, to supplement those of two or more teachers (AAP).

Another challenge when evaluating adolescents is obtaining and interpreting self-reports. Adolescents have a tendency to minimize their own problematic behavior [10]. Additionally, adolescents may be dissuaded from confronting symptoms as an ADHD diagnosis can carry a negative stigma because of peer referencing, and they may have misperceptions about the condition. In a recent study, participants who considered themselves very familiar with ADHD still maintained many misperceptions. For example, adolescents and parents alike (27 and 25%, respectively) still endorsed a sugar etiology [11[¶]]. Clinicians should be prepared to demystify ADHD and clarify any such misperceptions.

In adolescents, it is also markedly easier to falsely attribute other age-associated behavior and conditions to ADHD. The impact of new technologies cannot be ignored, and teens may find themselves distracted by the appeal of surfing the web, texting or video chatting with friends, or playing video games – alone or with others (at their side or 'virtually'). Of course, cable or satellite dish television with its abundance of programming provides even more video content for a teen's amusement (and distraction). Finally, web-based video on demand and digital video recorders further expand the panoply of video content that teens can watch. This myriad of options for personalized entertainment and/or social engagement at the push of a button imposes considerable challenges for the teen who is expected to do several hours of school work in the afternoon or evening. In this setting, it is not inconceivable that some teens will voice concern that they have ADHD because they cannot concentrate on their schoolwork [12].

The differential diagnosis for ADHD includes, but is not limited to, a broad array of mental disorders [e.g., depression, anxiety, sleep, mood, and substance use disorders (SUDs)]. Clinicians need to consider whether symptoms are due to ADHD or if there is another possible explanation for the teen's difficulties. For example, inattention or lack of focus in a classroom is commonly seen in students with a specific learning disorder. Although some learning disabled teens have ADHD as well, most students with learning disorder do not have ADHD. In this latter case, a student's inattention in class is likely secondary to a learning disability alone, and the student's academic focus would be more age-appropriate if needed compensatory educational strategies were employed. Inadequate sleep may also lead to symptoms suggestive of ADHD. Many adolescents are overextended or suffer from poor

time-management, resulting in sleep deficits that are associated with short attention span and academic underachievement. Thus, learning disabilities and sleep issues disorders are two common 'mimics' that may suggest ADHD in a teenager that clinicians need to identify and manage appropriately.

COMORBIDITY

ADHD symptoms may also be obscured by comorbidities. Although the aforementioned conditions and disorders may be mistaken for ADHD, many of the conditions that may mimic ADHD and be in the differential diagnosis for this diagnosis are also seen as a comorbid condition in patients with true ADHD.

Substance use disorder

Clinicians should take special care to screen adolescents with newly diagnosed ADHD for symptoms of SUD. If there is clinical evidence of substance abuse, providers should reassess the patients off the substance before writing any prescriptions. Adolescents with a comorbid SUD are more likely to misuse their ADHD medication. In a recent study from Harvard, children and adolescents with ADHD who developed SUD in the course of a 10-year follow-up study were found to abuse a variety of substances, with marijuana the most common substance endorsed for abuse and dependence. Interestingly, later SUD was equally common in individuals with the inattentive subtype at baseline as the combined subtype [13].

Oppositional defiant disorder and conduct disorder

There is a high co-occurrence rate of oppositional defiant disorder (ODD) with ADHD in adolescents. The coexistence of ODD or conduct disorder (CD) is often associated with a more severe presentation of ADHD [14]. Approximately, 40–65% [14] of young patients with ADHD also have ODD. In many patients, this ODD later develops into CD, which co-occurs with ADHD at a rate of 21–45% [14]. These rates of comorbidity are associated with criminal and antisocial behaviors such as theft and fire setting later in adolescence [14]. Patients with a combination of ADHD and CD are more likely to suffer from social dysfunction than those with only one of the diagnoses. Children with comorbid CD are also at a greater risk for SUD than those with only ADHD [15[■], 16]. ADHD without CD does not contribute to a higher risk for SUD. Although comorbid ODD

had been found to significantly predict substance and tobacco use disorders in both male and female ADHD patients [13], a more recent study found that comorbid ODD played no role in increasing the risk of nicotine dependence or SUD [15[■]].

Learning disabilities

Learning disabilities are a major concern amongst ADHD patients with regard to academic impairments. Although concordance rates vary considerably, approximately one-third of students with ADHD will also have a learning disability. Reading disabilities are the most commonly recognized form of learning disabilities, although patients with ADHD are also at increased risk for written language disorder and math-related impairments [17].

Autism spectrum disorder

The DSM-5 has eliminated autism spectrum disorder (ASD) from the exclusion criteria for ADHD, so children with ASD may now also be diagnosed with ADHD. Future research will hopefully provide greater insight into the true prevalence of comorbid ASD in children and adolescents with ADHD, as well as the most effective treatment strategies. Although atypical neuroleptics are approved by the Food and Drug Administration (FDA) for the treatment of irritability in children with autism and are often prescribed for youth with ASD as well as hyperactivity and other externalizing symptoms, risperidone and aripiprazole should not generally be considered first-line or second-line medications for ADHD. It is currently suggested that clinicians start adolescents with both disorders on very low doses of stimulants. Nonstimulants – atomoxetine or the α -2 agonists (guanfacine and clonidine) – may be considered as second-line medications or adjuncts if helpful.

Mood and anxiety disorders

The impaired social and academic performances associated with ADHD may contribute to low self-esteem or dysthymia in addition to that already typical of adolescence. Depression is likely to co-occur with ADHD in 25–30% of cases [14]. In the case of a major mood or depressive disorder, clinicians may refer patients to a developmental-behavioral pediatrician, psychiatrist, or other mental health subspecialist [1[■]]. Treatment of conditions such as severe depression and bipolar disorder should be prioritized over ADHD.

Although anxiety disorders are a relatively common co-morbid condition in children with ADHD,

studies suggest that anxiety disorders are not more prevalent in children with ADHD [14,18]. Adolescents with ADHD and an anxiety disorder would likely benefit not just from medication, but from psychotherapy as well. Clinicians can now feel comfortable choosing stimulants as a first-line medication for youth with ADHD and anxiety, as anxiety is no longer identified as a contraindication to treatment with stimulant medication. If ADHD symptoms do not respond adequately to stimulant therapy, atomoxetine may be a helpful second-line or adjunct medication. Depending on the severity of the anxiety and other clinical factors, treatment with a selective serotonin reuptake inhibitor (SSRI) may be indicated. SSRIs can generally be used safely in conjunction with stimulants. On the contrary, there are interaction effects between atomoxetine and some of the SSRIs (i.e., paroxetine and fluoxetine), so clinicians need to be cautious when combining an SSRI with atomoxetine, a selective norepinephrine reuptake inhibitor (SNRI) [19]. Comorbid anxiety disorders have also been shown to give rise to more sleep disturbances in adolescent patients than an ADHD diagnosis alone. When given a survey on sleep habits, patients with comorbid anxiety reported delayed sleep onset, night wakings, and bedtime resistance – more so than ADHD patients without anxiety [20].

Sleep disorders

As mentioned earlier, sleep disorders or deficits can lead to significant behavioral problems, including inattention and hyperactivity. It is important for clinicians to get a good sleep history when evaluating any teen for issues related to behavior, mood, attention, or academic difficulties. In patients with ADHD, clinicians need to also consider to what extent treatment with stimulants or other medications may be affecting sleep. Emphasis should be given to establishing and maintaining good sleep hygiene. Although melatonin is commonly used by teens (and others) to assist with sleep onset and appears to be generally safe and effective, its routine use should be discouraged.

Malingering

Students, especially in high school, face mounting pressure from parents and teachers to succeed academically. In light of these pressures, some non-ADHD adolescents may seek out an ADHD diagnosis from their healthcare provider in hopes of getting a chemical edge in the classroom. Last summer, *The New York Times* published an article chronicling the accounts of students who used or sold stimulants

without a legitimate ADHD diagnosis [21]. Several students divulged their tricks for convincing providers to give them ADHD medication, from storytelling about troubles focusing in the classroom to even falsifying symptoms during the appointment [22]. Although students should strive for excellent grades in their academic performance, teens should not seek stimulants as a means to an end. Providers must carefully examine the clinical history of any high school student presenting with de-novo concerns about ADHD and determine whether there are legitimate reasons for the teen's late presentation. Providers should also consider the role of parents in setting unrealistic expectations for their teens. Disheartening as it may be for some parents and teens, 50% of all teens will always be in the bottom half of their class!

TREATMENT

The AAP recommends that primary care providers, with the assent of the adolescent, prescribe FDA-approved medications as the primary means of treatment of ADHD in adolescents. Compared with nonstimulants such as atomoxetine and the α -2 agonists, the AAP notes that stimulants have a much broader evidence base and also have a larger effect size [2].

Stimulants

For adolescents diagnosed in childhood, the current stimulant options should be familiar, and the most frequently prescribed medications are extended-release formulations of methylphenidate and amphetamines. In 2010, methylphenidate was the top prescribed drug for patients aged 12–17 [23]. In some cases, clinicians may find it appropriate to prescribe higher than the FDA-approved dose for older patients to optimize the drug's effect. A common example is Osmotic Release Oral Systems methylphenidate; although the highest FDA-approved dosage is 72 mg for adolescents, clinicians may occasionally need to prescribe a higher dose to optimize benefits.

If a patient fails to benefit from trials with two or more different stimulant medications, the clinician should explore the following issues: lack of adherence (compliance) with medication administration, inaccurate diagnosis, confounding comorbidity, biased feedback about medication response, or inappropriate or unrealistic expectations for medication response.

Other adolescent-specific concerns for treatment are duration of benefit and dosing flexibility. Adolescent patients often carry out busier and

longer days than their younger counterparts. Thus, it is important that these patients are prescribed doses that will meet their varying schedules and needs for extended coverage. Consideration must be made for adolescents to ensure an easy administration routine that gives adequate coverage beyond the school day, encompassing the hours of club activities, homework, and driving. Although extended-release medications with long durations of benefit may allow adequate coverage with once-a-day dosing, it is not uncommon to supplement an extended-release medication in the morning with an immediate-release medication in the afternoon. Other options would be to add a nonstimulant to provide some supplemental benefit at the end of the day. Rarely, teens will occasionally seek treatment just with short-acting stimulants – for them to take as needed throughout the day. Although this may be reasonable with some students, clinicians must remember that these immediate-release medications are the formulations most easily misused or abused.

Nonstimulant medication

There are many circumstances wherein a clinician may choose to prescribe a nonstimulant medication for ADHD. One major concern with teens is diversion of ADHD medication. Diversion is the transfer of stimulant medication to others who do not have a prescription for the drug (i.e., selling, trading, or freely distributing). Although the risk of diversion may be greatest with short-acting stimulants (which can be easily ground up and snorted), diversion is possible with any form of stimulant. One recent study found an increased likelihood of the misuse of osmotic-release methylphenidate in adolescents with comorbid SUD [24]. Thus, the AAP recommends that clinicians pay careful attention to their adolescent patients – taking note of reported symptoms as well as frequency of prescription-refill requests [2nd]. Hopefully, close supervision of treatment of adolescents with ADHD will prevent negative consequences and minimize diversion.

In its revised clinical guidelines, the AAP suggests that FDA-approved nonstimulant medications be prescribed instead of stimulant medications when there are concerns about stimulants being abused or diverted. Extended-release guanfacine and clonidine are suggested as the preferred nonstimulant medication options [2nd].

Aside from their reduced likelihood for diversion when used as monotherapy, the extended-release α -agonist medications appear to be effective adjuncts to stimulant treatments. In a recent multicenter, double-blind, placebo-controlled, dose-optimization study in which extended-release guanfacine was given to children or adolescents with ADHD up to

age 17 years in addition to a long-acting stimulant, a morning or nightly dose of the nonstimulant led to significantly greater improvement in ADHD symptoms than in those treated with psychostimulant alone [25]. Extended-release clonidine has also had success as an adjunct to stimulant treatment, but only in children and adolescents with the hyperactive and combined subtypes [26].

Other treatment options

Aside from typical stimulant and nonstimulant medications, there are new ADHD drugs in development – including edivoxetine, a selective norepinephrine reuptake inhibitor of the atomoxetine family. A single dose daily of edivoxetine has been found to significantly reduce ADHD symptoms in adolescents for up to 8 h [27th].

Another avenue of treatment for ADHD is complementary and alternative medicine (CAM). There is considerable public interest in CAM approaches, and many different CAM treatments are being investigated (some more scientifically than others). Unfortunately, a detailed analysis of CAM treatments is beyond the scope of this article. Although the AAP's 2011 revised clinical guidelines did not recommend or endorse any CAM treatments, several studies subsequently published lend further support to the suggestion that essential fatty acid supplementation (i.e., fish oil pills) may be safe and somewhat beneficial in reducing ADHD symptoms [28]. Unfortunately, the effect size is very modest (0.3) and is not evident until 2–3 months of supplementation; thus, clinicians and families will likely need to pursue treatment with FDA-approved medications to achieve a more robust treatment effect.

Psychosocial and educational interventions

Several nonpharmacologic treatment options may also be helpful to adolescents with ADHD. These include, but are not limited to, family counseling, academic interventions, and behavior modification, which the AAP recommends specifically as a second line of treatment after medication [2nd,29].

Depending on the degree of academic impairment, students with ADHD may qualify for special education services or educational accommodations. If the adolescent does not already have either an accommodation plan (also known as a '504 Plan') or an Individualized Education Program (IEP), clinicians should help patients and their families initiate the evaluation process so they may apply for special academic services [29]. A 504 Plan qualifies a student for accommodations within a general education setting, such as modified homework and testing procedures, whereas an IEP provides students access to special education options [14]. In addition, many

standardized tests (i.e., Advanced Placement, SAT, and ACT) offer special testing accommodations, such as extra breaks between sections and extended time [30,31]. Just as some teens may seek an ADHD diagnosis for a 'chemical edge' from stimulant medication, others may seek the diagnosis in the hope that they can get extended time for standardized college admission tests.

Adherence to treatment

The AAP encourages primary care providers to view ADHD as a chronic condition and emphasizes the importance of treatments being maintained. Unfortunately, longitudinal studies have shown that treatments are often not maintained and that discontinuation of therapy puts children and adolescents with ADHD at greater risk. Many factors contribute to treatment adherence in adolescents, including stability of home life, simplified medication routines, lack of severe side-effects, motivation to improve ADHD symptoms, and quality of patient-provider relationship. It is also important to educate families about the nature of ADHD and the significance of treatment plans. Both parents' and adolescents' attitudes toward ADHD medication play crucial roles in how willing adolescents are to pursue and comply with treatment plans [32].

In addition to educating adolescents about ADHD, providers must make it a point to include them in the decision-making process revolving around their treatment. A recent study notes that adolescents are able to understand the potential benefits and risks of stimulants comparably to their parents [33]. Moreover, the AAP guidelines recommend that clinicians prescribe ADHD medications only with the adolescent's assent, highlighting the importance of the patient in the treatment process. Promoting adolescent patients to a position of authority in the scope of their treatment helps adherence by reinforcing an internal locus-of-control as well as acknowledging the adolescent's mounting independence as they enter adulthood.

Diversion

As noted earlier, diversion of stimulant medication is an increasingly common and concerning problem in adolescent populations. Patients most at risk for stimulant diversion are whites, members of fraternities and sororities, patients with low grades, patients with immediate-release preparations as compared with extended-release ones, patients who self-report ADHD symptoms, and patients with comorbid substance or conduct disorders [34].

Research has revealed that 16–23% of high school-aged and college-aged patients were encouraged by peers to share their stimulant medication

[34]. Moreover, 4–6% of these patients had their medication stolen from them [34]. It is important for clinicians to acknowledge the problem of diversion and take the necessary steps to help prevent it. Adolescents should be made aware of the consequences of diversion – especially the legal repercussions. The Drug Enforcement Administration groups ADHD stimulants such as methylphenidate and amphetamine in the same class of drugs as cocaine and morphine, and their sale or distribution is considered a felony.

DEVELOPMENTAL CHALLENGES IN ADOLESCENTS

The teenage years present challenges to parents and professionals alike. A diagnosis of ADHD often adds an additional layer of risk or complexity for all.

Risk-taking behavior

Adolescents with ADHD are likely to partake in more risk-taking behavior than their neurotypical peers, putting them at an increased risk for automobile accidents, substance abuse, promiscuity and sexually transmitted diseases, and accidental death. Studies have found greater incidences of injuries and hospital admissions in children and adolescents with ADHD than those without – especially in patients between 12 and 18 years of age. Treatment with ADHD medication is, however, thought to decrease some of this risk. A recent study found that ADHD children and adolescents on medication had fewer injury-related hospital admissions than those who were unmedicated; however, the risk of injury generally was still higher for this medicated ADHD population than controls [35].

Adolescents with ADHD are also at a greater risk for later antisocial behavior including fighting, acts of aggression, and delinquency. However, there is now evidence that implies that pharmacological treatment may decrease criminal behavior in ADHD patients. A database analysis of 25 656 Swedish ADHD patients found that the use of ADHD medication was inversely related to criminality risk. Although patients were medicated, their overall criminality rate decreased; however, these results were only noted during the treatment period, not after it had terminated [36].

Smoking and substance abuse

Tobacco and substance use disorders are highly associated with adolescent ADHD. ADHD has been found to be a significant risk factor for both nicotine dependence and substance abuse [13,15^{*}]. In some cases, experts believe that adolescents with ADHD may use cigarettes, nicotine agonists, and other

substances to self-medicate [37,38]. Smokers express feelings of increased attention while on nicotine [39], and other substances such as marijuana and alcohol have been used to alter mood or induce sleep [38]. Thus, ADHD patients who abuse cigarettes and other drugs may perceive or derive some secondary benefits from their substance use. Interestingly, a recent study also suggests that smoking risk may be related to ADHD subtype, as the subtype may influence how adolescents appraise the act of smoking as well as its potential benefits. Inattentive adolescents were more likely to overlook potential disadvantages such as addiction and health repercussions, whereas those with hyperactivity/impulsivity were more likely to emphasize potential advantages, such as boredom reduction and social benefits [40¹].

There is not yet a consensus on the effect of pharmacotherapy with stimulants on cigarette or drug use in patients with ADHD. Whereas one recent study suggests that extended-release methylphenidate may reduce the rate of tobacco use [41¹], another recent study found that stimulant use had no effect on future nicotine dependence in adolescents with ADHD [15¹]. There is similar controversy about the relationship between stimulant treatment and later drug use. Although some have expressed concern that psychostimulants may be gateway drugs, others have argued that stimulants may actually protect against SUD [33,42]. A very recent meta-analysis of 2565 individuals in 15 studies published between 1980 and 2012 found that stimulants alone neither increase nor decrease future risk of substance abuse, although sex differences may play some role [43¹].

Another point to consider briefly is the possibility of adolescents self-medicating with caffeine to increase alertness or focus. Patients should be aware of the caffeine content of different energy drinks or products they consume, which may contain as much as 242 mg of caffeine per serving (comparable to 2.5 cups of coffee) [44]. Clinicians should remind patients that caffeine is a stimulant, and that, when combined in high doses with methylphenidate or amphetamine, there may be increased risk for tachyarrhythmias and other complications.

Driving

Automobile accidents are the leading cause of adolescent deaths [45]. Because of their patterns of risk-taking behavior, ADHD is thought to largely contribute to the number of car accidents involving both male and female adolescent drivers [46]. These drivers are not only likely to have been involved in car accidents, but also more likely to be at fault than drivers without ADHD [47,48]. Additionally,

adolescent and young adult patients have been found not only to commit more traffic violations and receive more speeding tickets, but also to drive without a license or have their license suspended [47,48]. Thompson *et al.* [49] also noted an increased association of tickets and accidents in their follow-up analysis of a longitudinal ADHD study. Although the associations were not as great as those noted by Barkley *et al.* [47,48], this more recent study noted that persistence of hyperactivity/impulsivity into adolescence/young adulthood was an important mediating variable [49].

Stimulants and atomoxetine have been shown in many studies to help reduce driving-related risks in adolescents and young adults diagnosed with ADHD [50]. The most recent study of medication effects on driving focused on lisdexamfetamine dimesylate (LDX). As with other stimulants, treatment with LDX had a positive effect on driving performance in ADHD patients aged 18–26. After 6 weeks, participants on LDX had improved reaction times and fewer collisions than those on the placebo when completing a driving simulation [51¹]. Given the abundance of data demonstrating that ADHD compounds the risks typically associated with teen drivers and the equally abundant data documenting improvement in driving performance when treated with medication, clinicians should try to prescribe a pharmacotherapy regimen which would extend to the afternoon or early evening, when many teens with ADHD are driving. Although the AAP recommends prescribing either long-acting medications in the morning or short-acting medication in the late afternoon when treating ADHD adolescent drivers [2¹], clinical experience suggests that both are sometimes indicated.

Although currently there are no effective psychosocial interventions for ADHD-related driving problems, parents can also take steps to insure the safety of their teen with ADHD, such as limiting the time of day for driving and/or the number of peers who can ride with the adolescent driver.

Sexual behavior

The Milwaukee study, a longitudinal study comparing hyperactive and normal children, has produced significant findings with regard to sexual behavior. Although the study began before the term ADHD existed, many of the hyperactive patients observed would now meet the formal diagnostic criteria. A follow-up of these patients at around 20 years of age indicated that, compared with controls, hyperactive patients on average began having sexual intercourse at an earlier age (15 instead of 16) and had significantly more sexual partners (14 versus five). They are also nine times more likely to be involved in a

pregnancy; this risk is even more apparent for women [52]. Having comorbid CD in childhood increases the risk of early fatherhood as well as the likelihood of partaking in other risky sexual behaviors [2nd,53].

Increased risky sexual behavior was noted in the Pittsburgh Longitudinal Study, which compared young adults (aged 18–26) with and without childhood ADHD. Young men (aged 18–26) with ADHD reported earlier sexual debut, more casual sex, more sexual partners, and more pregnancies [53].

LOOKING BEYOND HIGH SCHOOL

Although graduation from high school is a major milestone for the adolescent with ADHD, long-term success is not assured, and pediatricians can play a meaningful role counseling teenagers and their parents about key planning decisions.

College

When choosing a college, students with ADHD should make sure to seek schools that are interested in and committed to working with students with ADHD and other learning disorders. The law requires that all colleges and universities that receive federal funding give ‘reasonable accommodations’ to assist students with ADHD [54]. It is important to remind students that the best school for them is not necessarily the most selective or highest-ranked school, but rather the school in which they are mostly likely to thrive while being challenged. Adolescents with ADHD should not set themselves up for failure and enter a situation that is likely to damage their self-confidence or otherwise hinder their chances of succeeding.

Students should also evaluate the potential support systems available to them on campus, from coaches to therapists to medical personnel, especially when out-of-state. In addition to assisting with school selection, clinicians should help adolescents plan for college life and learn how best to cope with their symptoms when they arrive. Foremost, students must embrace their ADHD and understand that they will need to seek out help. The first semester is crucial for establishing a good routine and ultimately the foundation for a good college career. It may be prudent for a new college student with ADHD to take a reduced load during the first semester so that they can get used to the level of work early on and bolster their confidence. Students should not only seek accommodations, such as extended time for tests, tutoring centers, and even possibly a scribe for note taking, but also make use of classes for study skills and time management. Clinicians should acquaint themselves with some of the on-line and print resources that delineate which schools may be

best suited for students with learning disabilities and/or ADHD [55,56th]. Students should also be encouraged to develop positive self-care habits (e.g. getting adequate sleep, exercise, and nutrition) and stress-management techniques [54]. Some students may benefit from an ADHD ‘coach’ – a nonlicensed professional who helps students organize and prioritize so that they meet their academic commitments successfully and on time.

Most importantly, clinicians should emphasize the importance of adhering to previously established treatment plans and avoiding diversion. Preventing diversion includes finding ways to safely store ADHD prescriptions so that others do not steal them.

Military

Although many adolescents are interested in entering the military, patients with ADHD are sometimes ineligible to enlist. Although an ADHD diagnosis does not disqualify someone from enlisting, a history of immaturity or impulsiveness, deficiencies in prior work or school performance, and current use of ADHD medication are all grounds for disqualification. Additionally, enlistees are not allowed testing accommodations during their timed examination. Nevertheless, military services maintain the right to issue waivers to individuals who do not necessarily meet the basic eligibility criteria but show promise for adequate performance. Demonstrating success over time in an academic or work setting as well as discontinuing ADHD medication use for 1 year are both crucial steps to ensuring a waiver [57,58].

Adulthood

Whereas some teenagers will ‘outgrow’ their ADHD in the course of their adolescence, many teens with ADHD end up being adults with ADHD. It is important that, as adolescent patients transition into adulthood, they maintain contact with their provider and keep up with their treatment as long as is clinically recommended. Although a detailed discussion of adult ADHD is beyond the scope of this article, there is a growing follow-up literature documenting how extensive the psychosocial morbidity may be. In one recent study from Harvard, adults who self-reported ADHD were more likely than the control group to have been divorced, been arrested, dropped out of high school, used recreational drugs, or be addicted to tobacco or smoking. Additionally, a greater proportion of these patients made less than \$25 000, and a lesser proportion graduated from college or attained a postgraduate degree [59].

ADHD in adolescence is also predictive of SUD in adulthood [60,61]. ADHD in adolescence also has a strong association with adult depressive mood

and anxiety disorder [62]. A longitudinal study of 14–16-year-old teens two decades later found that adolescent ADHD was significantly associated with diminished physical and psychological health as well as an increased likelihood of antisocial personality disorder. In addition, adolescent ADHD significantly predicted work performance issues as well as finance-related stress [59,62,63]. In short, ADHD takes its toll well beyond academic performance in the classroom. Although effective treatment with medication does not mitigate all risks, clinicians should strive to make sure that teens with ADHD receive as much support and treatment as clinically warranted.

CONCLUSION

ADHD is generally considered the most prevalent neurodevelopmental disorder in children. To the extent that ADHD persists into adolescence for the majority of affected youth, it is essential that clinicians are comfortable with the assessment and treatment of this disorder in teenagers. Healthcare providers must be familiar with DSM-5's revised diagnostic criteria and with the AAP's updated Clinical Practice Guidelines. Moreover, clinicians who care for teens with ADHD must be vigilant in recognizing not only the many psychosocial risks associated with this condition, but also the common comorbid psychiatric disorders.

Teens with ADHD are at increased risk for a multitude of adverse outcomes. It is believed that a comprehensive approach to management of ADHD in teenagers will optimize later functioning. John Milton, the renowned 17th-century English poet, wrote that 'the childhood shows the man, as morning shows the day'. When it comes to our teenage patients with ADHD, it is our goal – our job – as pediatricians to prove John Milton wrong!

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Conflicts of interest

There are no conflicts of interest.

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- of special interest
- of outstanding interest

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