



Inattention and impulsivity in children and adolescents: a developmental and contextual framework to understand attention-deficit hyperactivity disorder and its variants

Peter S. Jensen

University of Arkansas for Medical Sciences & Founder & Board Chair, The REACH Institute, New York, NY, USA

Correspondence to: Peter S. Jensen, MD. Adjunct Professor of Psychiatry, University of Arkansas for Medical Sciences & Founder & Board Chair, The REACH Institute, New York, NY, USA. Email: PeterJensen@TheREACHInstitute.org.

Abstract: Inattention and impulsivity are common characteristics of children, yet we do not expect young children to sustain attention and inhibit their natural impulses to the same extent as adults. During development, caregivers naturally train their children in these attentional and impulse regulation skills to increase their capacity to delay gratification. However, when elevated or more extreme problems of inattention and/or impulsivity are present in a child, other factors must be considered in order to evaluate specific instances of “inattention” and impulsivity, and to determine whether and how to intervene with a child who appears to manifest such difficulties. In this report, we review the problems of inattention and impulsivity in children within a developmental and ecological perspective. We couple this developmental-contextual perspective with studies of the formal diagnosis of attention-deficit hyperactivity disorder (ADHD), its causes, precursors, and treatment, and apply this perspective to the diagnosis of ADHD as well as to intervention approaches—both traditional medical treatments as well as more development-contextual interventions. A developmental-contextual framework to understanding inattention and impulsivity in children and adolescents offers clinicians important therapeutic advantages. Thus, this framework of necessity requires that clinicians consider the impact of family, peer, and school settings on the actual expression and severity of a child’s specific symptoms, and based on that understanding, that they consider possible interventions/modifications of those environments as a means of assisting the child. We also review the role of medication treatments and specific principles of medication prescribing within our developmental-contextual framework.

Keywords: Inattention; impulsivity; attention deficit hyperactivity disorder; development; context

Received: 19 November 2020; Accepted: 08 June 2021; Published: 28 February 2022.

doi: 10.21037/pm-20-99

View this article at: <https://dx.doi.org/10.21037/pm-20-99>

Introduction

Compared to adults, inattention and impulsivity are common characteristics of children. These two phenomena are *developmental*, which essentially means that we do not expect young children to remain attentive during a long verbal lecture, even though that skill and behavior is commonly required of adolescents in school or adults in the workplace. During the process of rearing a child, caregivers naturally and gradually train their children in these skills and increase their expectations that a developing

child extend his/her attention span and the capacity to delay gratification.

Much like height, muscle mass, and intelligence, across any population, children differ from each other in their intrinsic abilities to attend to specific stimuli and to delay gratification, or their inverse, inattention and impulsivity. These differences across children are a function of genetic/intrinsic factors, as well as environmental forces, such as nutrition and environmental stimulation.

While these above statements constitute self-evident

and obvious facts, when problems of inattention and/or impulsivity are present in a child, other factors must be considered if one is to adopt a fully informed picture of how to evaluate specific instances of “inattention” and impulsivity, and whether and how to intervene or assist a child who appears to manifest such difficulties.

In this report, we review the problems of inattention and impulsivity in children within a developmental and ecological perspective and apply this perspective to the diagnosis of attention-deficit hyperactivity disorder (ADHD) and its treatment.

ADHD from a developmental/contextual perspective

A simple analogy will help us apply a developmental and contextual perspective to an individual child’s success in devoting sustained attention to any given stimulus. Consider a radio signal that conveys important message. The extent to which a signal might reach a receiver varies by not only by the transmitter (e.g., the strength or clarity of the signals it sends), the receiver (is it tuned to the right frequency; does it have the capacity to amplify the signal if needed; its ability to filter out any extraneous signals), and the environment in which the signal is sent (e.g., background noise; other competing signals). Below we discuss these three general categories—transmitters, receivers, and the environments in which signals are sent, and apply this conceptual model to one of the most common behavioral disorders of children and adolescents, ADHD. To provide a contextual framework for ADHD, we begin first with issues/problems with transmitters and their signaling environments, before turning our attention to problems with receivers (children) and the traditional assumptions about ADHD, i.e., a “problem” that occurs within a specific child.

Transmitter issues/problems

For the challenges of teaching and/or raising children, adults typically are the “transmitters.” Parents and teachers vary in their ability to send clear signals (instructions, requests, information) to children. For example, within school settings, a given child may find that s/he has a favorite teacher or subject. Why? Some teachers may be more capable at story-telling, use of humor, or making a given subject interesting, simply by differences in how they use their voice (e.g., pace, volume, intonation, inflection),

use of visual aids or analogies to accompany their key messages, and even how they adapt their messages to the developmental capacities of children, such as sending briefer messages to accommodate younger children’s limited capacities for sustained attention, before they switch to another task or learning activity. Through a combination of natural skills or hard-won experience, capable teachers learn to send their messages (facts or content to be learned) accompanied by emotions that increase the power of the signal on children, such as humor, suspense, novelty, or surprise. Capable teachers understand that for children to learn effectively and maximally, they must feel safe and supported within the learning environment, so the teacher must attempt to foster positive relationships with the students, especially those that may be struggling. If a given child feels that the teacher “doesn’t like” him/her, such emotions produce competing signals within the child that will interfere with the child’s learning and attempts to mastering the learning/attentional tasks.

Within home settings, parents also impose necessary demands on their children for following instructions, completing homework tasks and household chores, following behavior rules, and gradually acquiring more abilities to regulate their own behaviors and complying with societal expectations. Capable parents will understand that younger children may require simpler rules and easier instructions than older children. Such parents will also patiently teach their children “why” it is important to perform certain behaviors (teeth brushing, sharing toys, not hitting or screaming when they are upset), and will understand the importance that other constructs are gradually taught and reinforced within the family/home setting (e.g., patience, fairness, self-esteem, using language to describe one’s feelings). Capable parents will adapt their messages to the age/developmental capacities of a given child, such that complex skills and values are gradually taught and reinforced over time and further adjusted based on their children’s responses and capacities.

Thus, for any child who comes to clinical attention in a pediatric or mental health setting because of school/learning or home behavioral difficulties, the evaluating clinician must carefully consider how any difficulties with inattention or impulsivity may be a function of “transmitter” problems/issues. For a particular child, the optimal strategy might need to include adjustments to transmitter issues – such as having a teacher make adjustments to their teaching strategy, or intervening with parents to change their parenting strategies. We will consider these issues more

fully below under the topic of “interventions” for children with ADHD.

Signals and signal environments

In any setting, there are a host of different signals that an individual might respond to. Consider the complexity of the signal environment in a typical classroom. A child sitting toward the back of the classroom has many competing signals—the teacher at the front of the classroom talking about tedious grammar rules, the nearby classroom window where children can be heard playing during recess, the friend in nearby seat who has fancy new sneakers, two other children nearby who are surreptitiously passing messages to each other, or the child’s internal worries or distractions—the parental argument the child overheard the night before, the bully that s/he might encounter between classes.

Similar signal complexity exists in home and peer settings as well. The parent may hope that the child will sit at the kitchen table and complete their school-assigned homework, but how might the TV or radio noise in the background, the phone ringing, or a crying sibling compete with the less interesting signals from a boring piece of paper with a long list of math problems or questions?

Some stimuli will be too complex for a given child. The parent with more than one child may discover that even the process of giving instructions must be simplified and tailored: one child may have no difficulty in completing a complex set of instructions—“go upstairs, brush your teeth, put on a clean shirt, and get your backpack”, while another child might only be able to follow a single instruction. And this capability will vary even within a given child: s/he might only be able to handle only one instruction at age 5 but can then handle a more complex set of instructions at age 15.

As “transmitters of signals” to children, wise parents and teachers will appreciate (or learn from hard experience) that they must take specific steps to ensure “signal strength” for the messages that they send to children. For example, have they established eye contact with the child before sending a signal? Is the child in close proximity, or is s/he in another room? Is the child doing something else that has engaged his/her attention? As signal transmitters, are the adults sending “mixed signals”, e.g., a tone of voice that elicits the child’s anger rather than his/her cooperation? Have they increased signal strength by increasing its salience and attractiveness by tying cooperation with the signal instructions to a reward for its completion? If the child is trying to complete an assignment, do the teachers/parents

try to eliminate competing signals (TV, other children entering the room, classroom distractions, etc.).

Thus, if a child (or group of children, e.g., in a classroom) has/have trouble attending to a task, these principles suggest that parents and teachers might have multiple options to consider to engage children’s attentional capacities: increase the novelty of the stimuli, increase the signal strength of the stimuli (e.g., louder volume, closer classroom position, increase use of visual aids so that the stimulus is delivered across more input channels, tie rewards to completion of tasks/stimulus requests), decrease external distractions (background interference), or simplify stimulus complexity, etc. Rewards must be judiciously used, with an understanding of the child’s context such that rewards are not used to circumvent or thwart other developmental needs, such as a “rewarding” a child to perform a specific behavior which in fact triggers memory of a trauma.

Let us now turn to “the receiver”, i.e., a given child or children who may come to clinical attention because of pronounced difficulties with appropriate responses to stimulus demands in home or school settings. From this perspective, we will review the more extreme end of the developmental continuum manifested by children, known as “ADHD.” It is important to remember that when children have pronounced difficulties with inattention and/or impulsivity, they will also have difficulties with learning new skills, successful social interactions, following instructions in multiple settings (including as adults in the workplace), and even later skills such as parenting.

ADHD diagnosis

According to the American Psychiatric Association Diagnostic and Statistical Manual of Mental Disorders (DSM)-5 diagnostic criteria (1), ADHD consists of a pattern of behavior across multiple settings characterized by symptoms of inattention and/or hyperactivity/impulsivity lasting 6 months or longer that are inappropriate/inconsistent with age/development level, and that result in functional impairment. At least some symptoms of the condition must present before the age of 12.

Two general symptom patterns are present: first: inattention, consisting of at least 6 of 9 possible symptoms: carelessness; difficulty sustaining attention during activities; trouble following through; avoiding tasks requiring sustained mental effort; difficulties organizing; losing important items; easy distraction; forgetfulness in daily activities; and failing to listen when spoken to directly. Only

Table 1 Common co-existing behavioral, emotional and learning disorders

	% of co-occurrence with ADHD
Oppositional-defiant disorder	42.4 (30.5–48.4)*
Conduct disorder	14.4 (7.4–19.4)
Depressive disorders (major depressive disorder, persistence depressive disorder, etc.)	6.3 (1.1–10.4)
Anxiety disorders	38.7 (28.6–44.8)
Tic disorders	11.6 (7.2–15.1)
Learning disorders	16.0 (12.0–22.3)
Misc (other) disorders (bulimia, anorexia, etc.)	0.4 (0–2.2)

From the NIMH MTA Study Sample, 579 children assessed for ADHD across six sites (4). *, percentages in parentheses indicate the co-occurrence (frequency) range across 6 sites. ADHD, attention-deficit hyperactivity disorder.

5 symptoms are required in older adolescents/adults.

The second symptom pattern consists of hyperactivity/impulsivity symptoms, again with a minimum of 6 of 9 potential symptoms: squirming/fidgeting; unable to stay seated; running/climbing excessively, being on the go “as if driven by a motor”; talking excessively, blurting out answers; inability to wait turns, inability to perform leisure activities quietly; and intrusiveness/interrupting others.

According to these criteria, a child or adult may present with 1 of 3 different patterns: inattentive symptoms only (the “inattentive presentation”); hyperactive/impulsive symptoms only (the hyperactive/impulsive presentation), or both symptom types (the “combined presentation”). The combined presentation is most common among children, while the inattentive presentation is most common among adolescents and adults.

ADHD epidemiology

Studies of the prevalence of ADHD across the globe have generally reported that 5–10% of school-aged children are affected, with rates among boys generally 3–4 times higher than that of girls (2). Although rates vary considerably by country, most recent research suggests that these variations are principally due to differing sampling and testing techniques in studies that have been conducted². Reported prevalence rates in various studies are higher if symptoms (inattention, impulsivity/hyperactivity) are based only on rating scales, and do not consider requirements for the presence of functional impairment and/or symptoms in multiple settings (2).

ADHD is often under-diagnosed in children and adolescents (3). Children with ADHD also often

present with comorbid psychiatric diagnoses, including oppositional-defiant disorder, conduct disorder, learning disabilities, and anxiety disorders, and 70% of children with ADHD will have one or more of these overlapping conditions (4) (see *Table 1*). Over the course of development, as children with ADHD age, symptoms of inattention and impulsivity may drop slightly, while typical symptoms of hyperactivity decrease more dramatically (5,6). Because of these changes with development, diagnostic criteria for ADHD in adults are relaxed, such that only 5 symptoms of inattention are required to meet diagnostic thresholds (1). Another caution is that childhood trauma can be a common cause of inattention and that children thus exposed may not respond to conventional medication treatment for inattention. Comprehensive assessment inclusive of detailed trauma history and physical examination, psychotherapy as appropriate, and psychosocial supports are most appropriate in the context of childhood trauma (7).

Etiology of ADHD

Evidence suggests that there is no single factor that determines the expression of ADHD. The emergence of ADHD is best viewed as a final common pathway for a variety of complex brain developmental processes (8). Multiple factors have been implicated in the etiology of ADHD (8). Mothers of children with ADHD are more likely to experience birth complications, such as toxemia, lengthy labor, and complicated delivery. Maternal drug use has also been identified as a risk factor in the development of ADHD. Maternal smoking and alcohol use during pregnancy are commonly linked to attentional difficulties associated with the development of ADHD (9).

There appears to be a strong genetic component to ADHD, with heritability estimates purported to be as high as 0.80 (10). Genetic studies across multiple populations have primarily implicated two candidate genes, the dopamine transporter gene (*DAT1*) and a particular form of the dopamine 4 receptor gene (*DRD4*), in the development of ADHD. Additional genes that may contribute to ADHD include *DOCK2* associated with a pericentric inversion 46N inv(3)(p14;q21) involved in cytokine regulation, a sodium-hydrogen exchange gene, and *DRD5*, *SLC6A3*, *DBH*, *SNAP25*, *SLC6A4*, and *HTR1B* (10,11).

Exposure to toxins, such as maternal smoking or alcohol use and postnatal exposure to lead, has also traditionally been correlated with ADHD (8).

Abnormal brain structures are linked to an increased risk of ADHD, because 1/5th of children with severe traumatic brain injury are reported to have subsequent onset of substantial symptoms of impulsivity and inattention. Structural (functional) abnormalities have been identified in children with ADHD without pre-existing identifiable brain injury. These include dysregulation of the frontal subcortical circuits; small cortical volumes in this region; widespread, small-volume reduction throughout the brain; and abnormalities of the cerebellum (12).

Psychosocial family stressors, such as parental conflict, poorly organized households, inconsistent parenting, child abuse/neglect, and other adverse childhood experiences may also contribute to or exacerbate the symptoms of ADHD (9).

Evaluation and diagnostic approach

A diagnosis of ADHD is made primarily in clinical settings after a thorough evaluation, including a careful history and clinical interview to rule in or to identify other causes or contributing factors; completion of behavior rating scales; a physical examination; and any necessary or indicated laboratory tests. It is important to systematically gather and evaluate information from a variety of sources, including the child, parents, teachers, physicians, and when appropriate, other caretakers.

Clinical interview and history

The clinical interview allows for a comprehensive understanding of whether the symptoms meet the diagnostic criteria for ADHD. During the interview, the clinician should gather information pertaining to the history of the presenting problems, the child's overall health

and development, and the social and family history. The interview should emphasize factors that might affect the development or integrity of the central nervous system or reveal chronic illness, sensory impairments, or medication use that might affect the child's functioning. Disruptive social factors, such as family discord, situational stress, abuse or neglect, and effects of migration/refugee status may result in hyperactive or anxious behaviors. A family history of 1st-degree relatives with ADHD, mood or anxiety disorders, learning disability, antisocial disorder, or alcohol or substance abuse may indicate an increased risk of ADHD and/or comorbid conditions.

Behavior rating scales

Behavior rating scales are useful in establishing the magnitude and pervasiveness of the symptoms but are NOT sufficient alone to make a diagnosis of ADHD. There are a variety of well-established behavior rating scales that have obtained good results in discriminating between children with ADHD and control subjects. These measures include, but are not limited to, the Vanderbilt ADHD Diagnostic Rating Scale (13), the Swanson, Nolan, and Pelham Checklist (SNAP) (14), and the Conners Parent Rating Scale (15), three of the most widely used measures. Consistent with best practices, each of these rating scales has both parent- and teacher-report versions reflecting reports from at least two different settings. Other broadband checklists, such as the Achenbach Child Behavior Checklist (CBCL) (16), are useful, particularly in instances where the child may be experiencing co-occurring problems in other areas (anxiety, depression, conduct problems).

Physical examination and laboratory findings

A comprehensive physical examination and developmental assessment are essential for all children. For children with a history of physical or sexual abuse or neglect, consideration should be given to referral to a specialty team skilled in such evaluations. There are no laboratory tests available to identify ADHD in children. However, the presence of hypertension, ataxia, an enlarged thyroid, or other physical findings should prompt further diagnostic evaluation. The clinician should also identify any possible vision or hearing problems. The clinician should consider testing for elevated lead levels in children who present with some or all of the diagnostic criteria, if these children are exposed to environmental factors that may put them at risk (substandard

Table 2 Medical/neurologic conditions sometimes associated with ADHD symptomatology

Thyroid disorders (including general resistance to thyroid hormone)

Heavy metal poisoning (including lead)

Adverse effects of medications

Effects of abused substances

Sensory deficits (hearing and vision)

Auditory and visual processing disorders

Neurodegenerative disorder

Post-traumatic head injury

Postencephalitic disorder

Fragile X

Fetal alcohol syndrome

Pervasive developmental and autism spectrum disorders

Adapted from Reiff MI, Stein MT. Attention-deficit/hyperactivity disorder evaluation and diagnosis: A practical approach in office practice. *Pediatr Clin North Am* 2003;50:1019-48. ADHD, attention-deficit hyperactivity disorder.

housing, old paint). Behavior in the structured laboratory setting may not reflect the child's typical behavior in the home or school environment. Therefore, reliance only on observed behavior in a physician's office may result in an incorrect diagnosis. Computerized attentional tasks and electroencephalographic assessments are not needed to make the diagnosis.

Differential diagnosis

As noted above, most children with ADHD will have one or more overlapping psychiatric conditions (*Table 1*), and these conditions can "mimic" ADHD as well. Thus, a child with anxiety or depressive disorder may have difficulties concentrating or completing tasks. Consequently, the wise clinician must not only rule out these other psychiatric conditions as the possible main causes of a child's inattention or impulsivity but must also consider that a given child may have ADHD plus one or more of these chronic psychiatric conditions.

In addition, there are a variety of medical conditions that can present with some symptoms of ADHD. In addition to other psychiatric disorders, ADHD symptoms can present as a function of medical illnesses (migraine headaches, absence

seizures, asthma and allergies, hematologic disorders, diabetes, childhood cancer). Such other chronic health conditions affect up to 20% of children in the U.S. and may impair children's attention and school performance, either because of the disease itself or because of the medications used to treat or control the underlying illness (medications for asthma, steroids, anticonvulsants, antihistamines) (see *Table 2*). In older children and adolescents, substance abuse may result in declining school performance and inattentive behavior (17)—hence the need for a complete medical and health assessment to rule out other conditions before the diagnosis of ADHD is presumed.

Treatment of ADHD

Given our understanding of ADHD, as well as the conceptual framework with which we began this report, it should be apparent to the reader that when a child/adolescent struggles with inattention and/or impulsivity, careful consideration must be paid during the diagnostic assessment about the ecological and developmental circumstances of the child's difficulties. To what extent might the child's difficulties be addressed by improving his classroom or home environments *vs.* simply assuming the problems lie solely within the child? Are the adult caregivers (parents or teachers) appropriately attuned to maximizing the nature of the stimuli ("signals") to which the child is required to attend, both at home and school settings?

Environmental/contextual interventions

Within a classroom that means that an attentive/skilled teacher recognizes that a host of simple enhancements might reduce a given child's difficulties, including placing him/her near the front of the classroom, avoiding seating him/her near any possible distractions, reducing/eliminating stimuli that might distract the child (such as peers the child loves to talk with), "cueing" the child when s/he notes that the child's attention has wavered/lessened, working to offer special rewards or consequences for the child to consistently demonstrate on task/attentive behavior, working with the parent to create strategies for the child to remember to write down any homework assignments, arranging for an aide to work with the child during periods/subjects of maximum inattentiveness, simplifying/eliminating complex instructions, or generally

improving teaching techniques (which might generally help all children in the classroom).

Home-based interventions

Within home settings, clinicians will find that for many parents with an inattentive/impulsive child, the first point of intervention involves teaching the parent(s) about the developmental and contextual nature of childhood inattention/impulsivity. The parent may need to learn patience with the child, and willingness to repeat instructions/requests. This might include even very simple steps that are too easily taken for granted, such as making eye contact with the child before making requests/giving instructions. Very often, when a parent presents to a clinical setting with a child with ADHD, clinicians will need to focus initial efforts in helping parents to build/rebuild positive relationships with the child, because the parent may have been frustrated over some period of time, and the child may have learned that the parent is often upset or frustrated with him/her, perhaps in comparison to other siblings in the family.

Behavior therapy

Often, parents will need hands-on coaching in how to use simple rewards and consequences with the child, how to simplify parental requests/commands/instructions, etc. The parent's learning how to reduce background stimuli when the child needs to attend to a difficult/boring task (such as homework) will not only reduce parental frustration, but also lead to improved self-esteem within the child. All of these specific steps are encompassed in what has been termed "parent training" or "behavior therapy." The training of parents in all of these individual steps involves hands-on coaching of the parents in how to pursue each step, and can be delivered via training parents in groups, or in individual training sessions for a single family. Note, this is dramatically different than any form of therapy directed specifically to a child. In a similar fashion, training can be focused on enhancing teachers' skills, not just in improving their teaching methods to maximize children's attention, but also in how they apply the principles and procedures of behavior therapy to one or more children in their classroom (18). Behavior therapy training for both parents and teachers is well established and efficacious in reducing children's problems with inattention and impulsivity, regardless of whether the child/ren have/have not been

diagnosed with ADHD (18,19).

Medication interventions

The most widely researched medicines used in the treatment of ADHD are the psychostimulant medications including methylphenidate (MPH), amphetamine (AMP), and/or various dextroamphetamine preparations. *Table 3* lists the most commonly prescribed medications for ADHD. Please note, this chart is necessarily incomplete, because at any given point in the last several years, several more medications are being tested and readied for marketing, but most new preparations are variations of MPH or amphetamine/dextroamphetamine compounds, based on tweaking the delivery system to ensure that the specific compound is released in the body in such a way so that it lasts all day. The most up-to-date listing of all currently prescribed ADHD medications can be found online (<http://www.adhdmedicationguide.com/>).

The longer acting, once daily forms of each of two major classes of stimulant medications (MPH or amphetamine/dextroamphetamine) are available and appear to facilitate adherence. Regardless of the specific stimulant form, both classes are equivalent and superior to the other medication types listed in the table (e.g., atomoxetine, clonidine, guanfacine, bupropion). For these reasons, prescribers should start with a stimulant medication (assuming parental willingness/consent), either MPH or an amphetamine compound (AMP). If a full range of MPH doses is used, roughly one fourth of patients will have an optimal response on a low (<20 mg/day), another fourth on a medium (20–40 mg/day), a third fourth on a high (>40 mg/day) daily dose, while a final fourth will be unresponsive or have side effects making that particularly unpalatable for the family.

Over the first 4 weeks the physician should upwardly adjust the medication each week as tolerated, obtaining parent and teacher rating scales for each week (while keeping side effects minimal to absent), in order to achieve maximum benefit with each child. If this strategy fails to yield satisfactory results, or if side effects prevent further dose adjustment in the presence of persisting symptoms, the clinician should use an alternative class of stimulant not used previously. In other words, if an MPH compound proves unsuccessful, the clinician should switch to one of the amphetamine products, or vice versa. If satisfactory treatment results are not obtained with the second stimulant class, clinicians may choose to prescribe

Table 3 Medications commonly used for treating ADHD

Generic name	Brand name	Duration (hr)	Dosage range	Side effects
Methylphenidate				
Immediate-release	Ritalin, Methylin	3–4	5, 10, and 20 mg tablets	Moderate appetite suppression, mild sleep disturbances, transient weight loss, irritability, emergence of tics
Extended-release	Metadate ER, Methylin ER,	4–6	10 and 20 mg extended-release tablets	Moderate appetite suppression, mild sleep disturbances, transient weight loss, irritability, emergence of tics
	Metadate-CD	8–10	10, 20, and 30 mg extended-release capsules	
	Ritalin LA	8–10	20, 30, and 40 mg capsules	
	Concerta	10–12	18, 27, 36, and 54 mg capsules	Moderate appetite suppression, mild sleep disturbances, transient weight loss, irritability, emergence of tics
	Sustained-release	Ritalin SR, Methylphenidate SR	4–6	20 mg sustained release tablets
Dexmethylphenidate				
Extended-release	Focalin	4–6	2.5, 5, and 10 mg tablets	Moderate appetite suppression, mild sleep disturbances, transient weight loss, irritability, emergence of tics
	Focalin XR	6–8		Moderate appetite suppression, mild sleep disturbances, transient weight loss, irritability, emergence of tics
Dextroamphetamine				
Short-acting	Dexedrine, DextroStat	4–6	5, 10, and 15 mg tablets	Moderate appetite suppression, mild sleep disturbances, transient weight loss, irritability, emergence of tics
Intermediate-acting	Dexedrine Spansule	6–8	5, 10, and 20 mg tablets	Same as for short-acting dextroamphetamine
Mixed amphetamine salts				
Intermediate-acting	Adderall	4–6	5, 10, and 20 mg tablets	Same as for methylphenidate
Extended-release	Adderall XR	8–12	5, 10, 15, 20, 25, and 30 mg capsules	Same as for methylphenidate
Atomoxetine				
Extended-release	Strattera	12	10, 18, 25, 40, and 60 mg capsules	Nervousness, sleep problems, fatigue, stomach upset, dizziness, dry mouth; may lead in rare cases to severe liver injury or to suicidal ideation
Bupropion				
Immediate release	Wellbutrin,	4–5	100 and 150 mg tablets	Difficulty sleeping, headache, seizures, irritability
Extended-release	Wellbutrin XL		100, 150, and 200 mg tablets	Difficulty sleeping, headache, seizures, irritability

Table 3 (continued)

Table 3 (continued)

Generic name	Brand name	Duration (hr)	Dosage range	Side effects
Clonidine				
Immediate-release	Catapres	3–4	3–10 g/kg/day bid–qid	Sedation, depression, dry mouth, rebound hypertension on discontinuing, confusion
Extended-release	Kapvay	18–24	0.1 mg qd, up to 0.4 mg in divided doses	Sedation, fatigue, dizziness, hypotension
Guanfacine				
Immediate-release	Tenex	12	0.5 mg qhs up to 4 mg in divided doses	Dry mouth, sedation, dizziness, constipation, headache
Extended-release	Intuniv	12–24	1–4 mg qd	Dry mouth, sedation, dizziness, constipation, headache

ADHD, attention-deficit hyperactivity disorder.

atomoxetine, a noradrenergic reuptake inhibitor that has been demonstrated to be superior to placebo in the treatment of ADHD in children, adolescents, and adults, and approved by the FDA for this indication. Atomoxetine should be initiated at a dose of 0.3 mg/kg/day and titrated over 1–3 weeks to a maximum dose of 1.2–1.8 mg/kg/day. Clonidine and guanfacine have also been approved by the FDA for treating ADHD. These alternatives to stimulant medication are generally considered “second-line”, given their smaller effects on ADHD symptoms.

Once an optimal medication and dose has been selected, the clinician should carefully and regularly monitor the child’s ongoing medication response as a necessary component of treatment in children with ADHD (4). Studies have shown that when physicians prescribe medications for the treatment of ADHD, but do not monitor frequently, they tend to use lower, rather than optimal, doses (4). Optimal treatment in most instances will usually require somewhat higher doses than tends to be found in routine practice settings. All-day preparations are also useful to maximize positive effects and minimize side effects, and regular medication follow-up visits should be offered (4 or more times per year), versus the twice yearly medication visits often given in standard community care settings (4,20).

Although up to 95% of children with ADHD do respond significantly to stimulant treatment (21), stimulant treatment alone may not “normalize” nearly half (45%) of children (4). It should be noted that medication alone is not always sufficient to treat ADHD in children, particularly in instances where children have multiple

psychiatric disorders or stressed home environments (4,22,23). When children fail to respond to medication, it may be appropriate to refer the child to a mental health specialist (23). Consultation with a child psychiatrist or psychologist may also be beneficial in order to determine the next steps for treatment, including adding other components and supports to the overall treatment program. Nonetheless, evidence suggests that children who receive careful medication management accompanied by frequent treatment follow-ups to monitor symptom control, all within the context of an educative, supportive relationship with the primary care provider, are likely to experience behavioral gains for up to 24 months (24).

Principles of appropriate prescribing

When considering medication as one of the treatment components to be employed by a prescriber, several key principles must be kept in mind.

Ensure an adequate trial of an appropriate medication

Every child with carefully-diagnosed ADHD deserves consideration of adequate trials of appropriate medications. As noted earlier, stimulants work in over 90% of children with ADHD (21). Regardless of the type of medication prescribed, all medications must be titrated, which requires close follow-up. The frequency and immediacy of the follow-up varies based on the potential side effect profile and the medication, the coadministration of other medications, and the clinical condition of the child. In other

words, the method and the frequency of the monitoring should be individualized to the needs of the patient and the family. Once the medication is stabilized and the child is doing well, follow-up visits every 1 to 3 months are generally consistent with high quality care.

Start low, go slow, but don't stop short

Although the “try it and see” approach is unavoidable, it is important to ensure that an adequate dose has been provided before changing medications or adding another. A “start low, go slow” approach is often best. Starting low can minimize potential side effects of medications and can provide time for other psychosocial interventions to have an effect. Going slow allows the prescriber and parents an appropriate period of time at a particular dosage in order to determine whether it provided any benefit. The goal should be to get the desired effect at the lowest possible dose. Although this rule must be respected, prescribers should also remember that available data suggest that most doctors treating ADHD typically start low, but also “stop short” (4,20). This problem can be avoided by using rating scales and by working to achieve full remission of symptoms, just as one might do with asthma. Neither the parent nor the prescriber would be satisfied if the child with asthma improved so that he or she didn't wheeze during class, but still wheezed during exercise. In the case of ADHD, most children can be helped to achieve symptomatic remission with adequate doses of medication (4), but most prescribers provide inadequate doses (4,20). Importantly, when starting medication, it is important to prepare families that multiple titration steps may be needed before an optimal dose can be determined.

Avoid polypharmacy

Polypharmacy, or the simultaneous use of more than one medication, should be avoided. Thus, only a single medication should be introduced at a time. Although there are instances when multiple psychotropic drugs must be administered, alternatives should be considered whenever possible. For example, if a child is having trouble sleeping as a side effect of a medication, its dosage or time should be adjusted first, rather than switching to another medication to combat the side effect. Better yet, environmental or behavioral interventions should be considered that could minimize the side effect or target symptom. For example, if the child has a decreased appetite at dinner time and has

begun to lose weight, he/she might be “rewarded” with a sticker or points to eat a bit extra, even if they are no longer hungry. In the case of ADHD medications, the optimal approach is try only single medicine, rather too low doses of several medications.

Systematically monitor side effects and symptoms

In order to assess a drug's benefits and drawbacks, it is critical to systematically measure both the response and possible side effects to the treatment. There are a variety of feasible no-cost, reliable methods that can be used to carefully monitor the side effects of the drug, as well as the child's response. Thus, the use of scales, diaries, and checklists not only provide a baseline measure of a particular condition, they also allow for the condition to be monitored over time. Additionally, the use of these tools has been shown to increase doctor-patient alliance and reassure the patient and family about the quality of care being received.

Consider a washout period

If it is unclear whether a single medication or a combination of multiple drugs is having little effect, a washout—a total withdrawal of all medications in order to start over—should be considered. Some medications may cause side effects that mimic psychiatric symptoms. Often, medications have been added to treat side effects of medications and carefully monitoring at each stage has been neglected. In these situations, it is reasonable to consider starting at a point from which the effect of each medication can be measured. Because considerable side effects are possible, it is important that the prescriber determine whether the benefit of the medication is greater than the potential risk. If the additive benefit is unclear, starting from scratch may be a better way to not only understand the effects of the medication, but also to clarify the diagnosis and target symptoms.

Reconsider the diagnosis and condition if no benefits are seen

Overreliance on previous labels and diagnoses should be avoided. If a child does not respond to a medication, the diagnosis and coexisting conditions should be re-examined, along with the treatment and the child's adherence to it. Because many conditions are comorbid and diagnostic categories do not always reflect complex reality, understanding the child and his or her diagnosis can be

challenging and frustrating. Prescribers should consider arranging regular discussions or follow-up assessments with a physician who is expert in the use of these medications in children with complex emotional or behavioral problems.

Fully involve the family and patient

When considering the range of proven therapeutic options, the family and the patient must be involved in decision making. This process is not only necessary to provide informed consent in regard to the medication, which includes explaining both the benefits and drawbacks for the use of the medication and other treatments to the family and youth, but also to gauge the attitudes and abilities of the family. It may be necessary to address misconceptions they may have toward the use of treatments, and to offer assistance to the family as they arrive at a decision about which treatment option is best for them. Parents should be provided with clear directions for the use of the medication, for what medication can be expected to accomplish, and for what the dangers of taking the medication are.

Another important principle is to help parents identify the symptoms that are being targeted, and what the goal of the medication will be and if there are comorbid conditions to understand that they likely will not be corrected by the stimulants. By using rating scale input from teachers and parents themselves, the prescriber will not only determine target behaviors of greatest concern to both the parents and child, but also can use these scales as family teaching tools, enabling them to learn about the symptoms and become more expert in tracking them.

Prevention

Perhaps the most important neglected areas in our understanding of ADHD pertains to possibilities for prevention. Very little research has been conducted on preschoolers with ADHD symptoms, and how one might effectively intervene during such periods where a child's innate developmental plasticity and the potential salutary effects of carefully crafted environments might be used to maximum benefit. Nonetheless, ADHD does present in preschoolers, and their particular presentation may be quite extreme—expulsion from multiple preschools, and extreme levels of hyperactivity that can actually put the child in frequent danger. In such situations, careful and intensive work with the child's caretakers is essential to prevent long-term adverse behavioral, social, and educational

consequences.

To the extent that parents, teachers, physicians, and policy-makers focus efforts on earlier detection, diagnosis, and treatment, prevention of long-term adverse effects of ADHD on affected children's lives should be considered as treatment goal, and as "secondary prevention." Given the effective treatments for ADHD now available, and the well-documented evidence about the long-term effects of untreated or ineffectively treated ADHD on children and youth, prevention of these consequences should be the goal of physicians and the children and families with ADHD for whom we are responsible.

Summary

Great strides have been made in the last four decades in our understanding of inattention and impulsivity of children and adolescents, particularly as these symptoms are considered in the context of the diagnosis of ADHD. When these symptoms are problematic for a given child and result in impairment in normal childhood development and functioning across multiple settings, various competing causes (both medical and psychiatric) must be considered and evaluated, to determine if the child in fact has ADHD. While having a child with the diagnosis of ADHD is never welcome news for any parent (much less the child or teen), once a careful and accurate evaluation is followed by interventions (behavioral therapy, medication and/or psychotherapy), most parents are relieved when they realize how much better their child can do at home, with peers, and at school. In fact, the last several decades' research advances in diagnosing and treating ADHD constitute some of the most remarkable successes in pediatric medicine.

Acknowledgments

Funding: None.

Footnote

Provenance and Peer Review: This article was commissioned by the Guest Editors (Danielle Laraque-Arena and Ruth E.K. Stein) for the series "Integrating Mental Health in the Comprehensive Care of Children and Adolescents: Prevention, Screening, Diagnosis and Treatment" published in *Pediatric Medicine*. The article has undergone external peer review.

Conflicts of Interest: The author has completed the ICMJE uniform disclosure form (available at <https://pm.amegroups.com/article/view/10.21037/pm-20-99/coif>). The series “Integrating Mental Health in the Comprehensive Care of Children and Adolescents: Prevention, Screening, Diagnosis and Treatment” was commissioned by the editorial office without any funding or sponsorship. The author has no other conflicts of interest to declare.

Ethical Statement: The author is accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

Open Access Statement: This is an Open Access article distributed in accordance with the Creative Commons Attribution-NonCommercial-NoDerivs 4.0 International License (CC BY-NC-ND 4.0), which permits the non-commercial replication and distribution of the article with the strict proviso that no changes or edits are made and the original work is properly cited (including links to both the formal publication through the relevant DOI and the license). See: <https://creativecommons.org/licenses/by-nc-nd/4.0/>.

References

1. American Psychiatric Association. DSM-5, American Psychiatric Press, Inc., Washington, DC, 2013.
2. Polanczyk GV, Willcutt EG, Salum GA et al. ADHD prevalence estimates across three decades: an updated systematic review and meta-regression analysis. *Int J Epidemiol* 2014;43:434-42.
3. Jensen PS, Kettle L, Roper MS, et al. Are Stimulants Over-prescribed? Treatment of ADHD in four U.S. communities. *J Am Acad Child Adolesc Psychiatry* 1999;38:797-804.
4. MTA Cooperative Group. A 14-Month randomized clinical trial of treatment strategies for attention-deficit/hyperactivity disorder. *Arch Gen Psychiat* 1999;56:1073-86.
5. Barkley RA, Fischer M, Smallish L, et al. The persistence of ADHD into young adulthood as a function of reporting source and definition of disorder. *J Abnorm Psychol* 2002;111:279-89.
6. Faraone SV, Biederman J, Mick E. The age-dependent decline of ADHD: a meta-analysis of follow-up studies. *Psychol Med* 2006;36:159-65.
7. Richard-Lepouriel H, Kung AL, Hasler R, et al. Impulsivity and its association with childhood trauma experiences across bipolar disorder, attention deficit hyperactivity disorder, and borderline personality disorder. *J Affect Disord* 2019;244:33-41.
8. Jensen PS. The National Institutes of Health Attention-Deficit/Hyperactivity Disorder Consensus Statement: Implications for Scientists and Practitioners. *CNS Spectr* 2000;5:29-33.
9. Jensen PS. ADHD: Current concepts on etiology, pathophysiology, and neurobiology. *Child Adolesc Psychiatr Clin N Am* 2000;9:557-72.
10. Faraone SV. Advances in genetics of ADHD. *Biol Psychiatry* 2014;76:599-600.
11. Brookes K, Xu X, Chen W et al. The analysis of 51 genes in DSM-IV combined type ADHD: association signals in DRD4, DAT1, and 16 other genes. *Molec Psychiat* 2006;11:934-53. Erratum in: *Mol Psychiatry* 2006;11:1139.
12. Castellanos FX, Proal E. Large-scale brain systems in ADHD: Beyond the prefrontal-striatal model. *Trends Cogn Sci* 2012;16:17-26.
13. Vanderbilt Parent Rating Scale. Available online: https://www.nichq.org/sites/default/files/resource-file/NICHQ_Vanderbilt_Assessment_Scales.pdf, 1 July 2020.
14. Swanson, Nolan, and Pelham Teacher and Parent Rating Scale. Available online: https://en.wikipedia.org/wiki/Swanson,_Nolan_and_Pelham_Teacher_and_Parent_Rating_Scale, 1 July 2020.
15. Conners CK, Sitarenios G, Parker JDA, et al. The revised Conners Parent Rating Scale (CPRS): Factor structure, reliability, and criterion validity. *J Abnorm Child Psychol* 1998;26:257-68.
16. Child Behavior Checklist. Available online: <https://store.aseba.org/School-Age-6-18-Materials/departments/11/>; 1 July 2020.
17. Molina BS, Hinshaw SP, Eugene Arnold L, et al. Adolescent substance use in the multimodal treatment study of attention-deficit/hyperactivity disorder (ADHD) (MTA) as a function of childhood ADHD, random assignment to childhood treatments, and subsequent medication. *J Am Acad Child Adolesc Psychiatry* 2013;52:250-63.
18. Wells KC, Pelham WE, Kotkin RA, et al. Psychosocial Treatment Strategies in the MTA Study: Rationale, methods, and critical issues in design and implementation. *J Abnorm Child Psychol* 2000;28:483-505.
19. Daley D, van der Oord S, Ferrin M, et al. European ADHD Guidelines Group. Behavioral interventions in attention-deficit/hyperactivity disorder: a meta-

- analysis of randomized controlled trials across multiple outcome domains. *J Am Acad Child Adolesc Psychiatry* 2014;53:835-47.
20. Jensen PS, Hinshaw SP, Swanson JM, et al. Findings from the NIMH Multimodal Treatment Study of ADHD (MTA): Implications and Applications for Primary Care Providers. *J Dev Behav Pediatr* 2001;22:60-73.
 21. Elia J, Borcharding BG, Rappoport JL, et al. Methylphenidate and dextroamphetamine treatments of hyperactivity: are there true nonresponders? *Psychiatry Res* 1991;36:141-55.
 22. MTA Cooperative Group. Moderators and mediators of treatment response for children with attention-deficit/hyperactivity disorder: the multimodal treatment study of children with attention-deficit hyperactivity disorder. *Arch Gen Psychiat* 1999;56:1088-96.
 23. Jensen PS, Hinshaw SP, Kraemer HC, et al. ADHD comorbidity findings from the MTA study: Comparing comorbid subgroups. *J Am Acad Child Adolesc Psychiatry* 2001;40:147-58.
 24. MTA Cooperative Group. 24-Month Outcomes of Treatment Strategies for Attention-Deficit/Hyperactivity Disorder (ADHD): The NIMH MTA Follow-up. *Pediatr* 2004;113:754-61.

doi: 10.21037/pm-20-99

Cite this article as: Jensen PS. Inattention and impulsivity in children and adolescents: a developmental and contextual framework to understand attention-deficit hyperactivity disorder and its variants. *Pediatr Med* 2022;5:8.