ADHD
DIAGNOSIS AND MANAGEMENT

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LEARNING OBJECTIVES

1. Explain the current evidence on the neurobiological basis of ADHD and the impact of this condition in the functioning of children and youth.

2. Implement a systematic evaluation and diagnostic approach for children and youth with ADHD based on the DSM-5 classification and AAP Guidelines.

3. Discuss evidence-based pharmacological and non-pharmacological treatment interventions for children and youth with ADHD.
CASE

• SM is a 7-year-old girl who was initially evaluated due to concerns about inattention and academic underachievement. She is in 2nd grade in a catholic school.

• She was reported to have difficulty focusing, staying on task, and to have difficulties with self-monitoring. She appears socially immature and sometimes does not keep personal space. She is behaviorally and emotionally reactive. These issues appear to be impacting her academic performance.

• Average student except in Art and Math where she is below average.
EVALUATION RESULTS

- A neuropsychological evaluation revealed a pleasant child who lacked confidence and appeared overwhelmed when exposed to tasks perceived to be difficult.
- She tried hard but was easily distracted. Difficulties with attention tasks in testing.
- Average IQ. Low average working memory, average verbal and non-verbal thinking, above average processing speed.
- High average scores basic reading, reading comprehension and spelling. Average scores in math.
- Behavioral questionnaires revealed significant inattention.
SECOND EVALUATION

• 9-year-old girl
• High average thinking skills with average working memory and processing speed.
• Average to high average academic achievement. Difficulties adhering to writing assignments instructions and with math problems.
• Attention skills were assessed to be on target.
CASE FOLLOW UP

• Parents agreed to try medication in 6th grade.
• SM and her parents reported that she presented a dramatic improvement in her social, academic and overall functioning when started on Focalin XR 5mg.
• She completed high school in a highly competitive private program. She was an A student and took some AP classes. She drove to school in her junior and senior years.
• She will go to college this coming fall
• There is some residual anxiety and social life is not great.
ATTENTION DEFICIT HYPERACTIVITY DISORDER

• ADHD is the most common neurobehavioral health condition among children.

• Researchers have identified ADHD in all nations and cultures studied.

• Prevalence rates range from 4%-12% (median 5.8%).

• Male-female ratios are 5:1 for predominantly hyperactive/impulsive type and 2:1 for predominantly inattentive type.
ADHD – SLIGHT REDUCTION IN SIZE IN 4 REGIONS OF THE BRAIN

1. Corpus callosum - connects the left and right hemispheres of the brain
2. Basal ganglia (AD/HD symptoms of mood regulation and controlling impulsive outburst)
3. Frontal lobe (AD/HD symptoms of organization, time management and decision-making)
4. Cerebellar vermis - connects the two hemispheres of the cerebellum

• *Neurology Today, 7:24, December 18, 2007*
Figure 1. Schematic representation of functional circuits involved in the pathophysiology of ADHD. Here are summarized the attentional network (green), the fronto-striatal network (yellow), the executive function network (black), the fronto-cerebellar network (red), and the reward network (blue).
ETIOLOGY

• The cause for ADHD remains unclear. It is currently thought to have a multifactorial origin.

• 20-25% of children with ADHD also have a diagnosis that can be associated with an organic cause. Fetal Alcohol Syndrome, exposure to other substances (cocaine, nicotine, lead), occurrence of trauma or infection that lead to CNS damage can result in ADHD symptom complex.

• 75-80% cases are thought to have a polygenic basis.

• Heritability of ADHD in twin studies has been estimated to be more than 50%.
NATURAL HISTORY

• 70-80% of children with ADHD continue to have difficulties through adolescence and adulthood.

• Symptoms usually change throughout the child’s lifetime. In general, hyperactive symptoms decrease overtime, while inattentive symptoms persist and may became more evident.
IMPACT OF ADHD

• Childhood: behavioral problems, academic underachievement, social difficulties, low self-esteem.

• Adolescents: higher rates of school failure, motor vehicle accidents, substance abuse, and encounters with law officials.

• Adults may achieve lower SE status and have more marital problems than the general population.
ACADEMIC OUTCOMES

• ADHD adversely affects long-term academic outcomes.

• A greater proportion of achievement test outcomes improved with psychopharmacologic treatment compared with academic performance.

• Both, academic achievement and standardized testing improved most consistently with multimodal treatment.
ADHD DIAGNOSIS

• The behaviors observed in ADHD differ in quantity, not quality, from those of typical children.

• No biological markers can discriminate children with ADHD.

• The frequency of these behaviors is observed and reported by the child’s caregivers.

• There is no consensus about what frequency of any given behavior is normal at any given age.

• The ADHD core symptoms and signs are not specific of this condition.
DSM 5 - ADHD

CORE SYMPTOMS
- 6/9 Inattention behaviors
- 6/9 Hyperactive-impulsive behaviors
- 5/9 of each for people older than 17
- Symptoms must be present prior to age 12

AND
- "...clear evidence that the symptoms interfere with, or reduce the quality of social, academic, or occupational functioning." No need for impairment.

- Symptoms are present in two or more settings.

- "The symptoms do not occur exclusively during the course of a schizophrenia or other psychotic disorder and are not better accounted for by another mental disorder." ASD is not an exclusion condition.
DSM-5 CRITERIA ADHD - INATTENTION

- often fails to give close attention to details or makes careless mistakes in schoolwork, work, or during other activities (e.g. overlooks or misses details, work is inaccurate).

- often has difficulty sustaining attention in tasks or play activities (e.g., has difficulty remaining focused during lectures, conversations, or lengthy reading).

- often does not seem to listen when spoken to directly (e.g., mind seems elsewhere, even in the absence of any obvious distraction).

- often does not follow through on instructions and fails to finish school work, chores, or duties in the work place (e.g., starts tasks but quickly loses focus and is easily sidetracked).

- often has difficulty organizing tasks and activities (e.g., difficulty managing sequential tasks; difficulty keeping materials and belongings in order; messy, disorganized work; has poor time management; fails to meet deadlines).

- often avoids or is reluctant to engage in tasks that require sustained mental effort (e.g. schoolwork or homework; for older adolescents and adults, preparing reports, completing forms, reviewing lengthy papers).

- often loses things necessary for tasks or activities (e.g., school materials, pencils, books, tools, wallets, keys, paperwork, eyeglasses, mobile telephones).

- is often easily distracted by extraneous stimuli (e.g., for older adolescents and adults may include unrelated thoughts).

- is often forgetful in daily activities (e.g., doing chores, running errands; for older adolescents and adults, returning calls, paying bills, keeping appointments).
DSM-5 CRITERIA ADHDHYPERACTIVE –IMPULSIVE SXS

- often fidgets with or taps hands or squirms in seat.

- often leaves seat in situations when remaining seated is expected (e.g., leaves his or her place in the classroom, in the office or other workplace, or in other situations that require remaining in place).

- often runs about or climbs in situations where it is inappropriate (e.g., in adolescents or adults, may be limited to feeling restless).

- often unable to play or engage in leisure activities quietly.

- often "on the go" acting as if "driven by a motor" (e.g., is unable to be or uncomfortable being still for extended time, as in restaurants, meetings; may be experienced by others as being restless or difficult to keep up with).

- often talks excessively.

- often blurts out answers before questions have been completed (e.g., completes people's sentences; cannot wait for turn in conversation).

- often has difficulty awaiting turn (e.g., while waiting in line).

- often interrupts or intrudes on others (e.g. butts into conversations, games, or activities. may start using other people's things without asking or receiving permission; for adolescents and adults, may intrude into or take over what others are doing).
ADHD SUBTYPES

DSM-IV
- Predominantly Inattentive type
- Combined type
- Predominantly Hyperactive-impulsive type

DSM-5
- Combined presentation
- Predominantly inattentive presentation
- Predominantly hyperactive-impulsive presentation
THE NICHQ VANDERBILT ASSESSMENT SCALE (PARENT OR TEACHER INFORMANT)

- 9 symptoms of inattention
- 9 symptoms of hyperactivity-impulsivity
- 10 symptoms of disruptive behavior
- 7 symptoms of anxiety and depression
- Academic achievement
- Classroom behavioral performance
ADHD DIFFERENTIAL DIAGNOSIS

• **LEARNING DISABILITIES**
  Learning problems that are not appropriately accommodated in the school setting.

• **LANGUAGE DISORDERS**

• **PSYCHIATRIC CONDITIONS**
  Delays in the diagnosis may lead to a poor or incomplete understanding and treatment of the child with subsequent impact in overall functioning.
  - Anxiety
  - Depression
  - Mood Dysregulation Disorders
  - ODD & CD

• **SITUATIONAL DISORDERS**
ADHD COMORBIDITIES

- Oppositional defiant disorder (35-40%)
- Conduct disorder (14-26%)
- Anxiety (26-34%)
- Depression (4-18%)
COMORBIDITY OF LD AND ADHD

• A total of 17 studies (2001–2011) examining ADHD-LD comorbidity were reviewed, revealing a higher mean comorbidity rate (45.1%) than has been obtained previously.

• Higher comorbidity may be the result of including students with writing disorders, not just reading and/or math disabilities.

• Academic skill and/or performance deficits assessments should be considered for students with ADHD as part of screening, comprehensive evaluation, and treatment monitoring.

• Comprehensive intervention services for students with comorbid ADHD and LD will require empirically supported treatment strategies that address both disorders and that are implemented across school and home settings.

• The primary care pediatric guideline has the unfortunate effect of making it more difficult to advocate for cognitive and educational evaluations as standard components of assessment for ADHD among school-age children who are evaluated in subspecialty clinics.

ADHD TREATMENT
ANOTHER CASE

- 6-year-old boy
- History of late talking and disruptive behavior
- History of hyperactive, impulsive and inattentive temperament
- Family history of ADHD
- Placement in a private therapeutic kindergarten
- Social-communication delays
- Average intellectual abilities. Learning difficulties
- Behavior is disruptive at home and school
MULTIMODAL TREATMENT STUDY (MTA) OF CHILDREN WITH ADHD

The MTA study (1,999) involved 579 children with combined ADHD, 7-10 years old, randomly assigned to receive methylphenidate (MPH), MPH and behavior management, behavior management alone or standard community care over 14 months.
MTA - Percent “normalized” at 14-month endpoint.
MTA STUDY: CONCLUSIONS

• Combined treatment and medication management were more effective than behavioral treatment and community care in reducing ADHD core symptoms.

• Patients in the combined treatment group experienced:
  - No significant difference in core ADHD symptoms vs. those in the medication management group.
  - Improvements in core ADHD symptoms at a lower dose than patients in the medication management group.
  - Modest advantages in non-ADHD symptoms and positive functioning outcomes vs patients in the medication management group.
PHARMACOTHERAPY

• First line ADHD drugs:

  STIMULANTS: Methylphenidates vs Amphetamines

• Second line ADHD drugs:
  
  - Guanfacine
  - Clonidine
  - Atomoxetine
  - Bupropion
  - Tricyclic antidepressants
The literature evidence supports psychostimulants as initial pharmacotherapy for ADHD, with additional options including atomoxetine and $\alpha_2$ agonists.

When one medication class does not provide adequate coverage for ADHD symptoms, combining medication classes can be beneficial.
STIMULANTS

• There is evidence that 70%-90% of individuals respond to stimulant medications

• **Methylphenidates** and **Amphetamines** are first-line agents for ADHD.

• Efficacy and response rates are well documented and are similar for Methylphenidate and Amphetamine medications, although as many as 25% of patients may respond to only 1 agent.

• Myths
• Length of action
• Titration
STIMULANTS - MECHANISM

Their primary mechanism of action involves blocking dopamine transporters, with additional effects including blockade of norepinephrine transporters, dampening action of monoamine oxidase (which slows dopamine and norepinephrine degradation), and enhanced release of dopamine into the synaptic space.
- Stimulants are also effective in children with ADHD and mental retardation.

- FDA encourages physicians to identify existing cardiac conditions but more stringent warning was not considered warranted.

- Although methylphenidate may increase the possibility of a seizures in a seizure disorder and dextroamphetamine does not, both medications have been used to treat ADHD in children with seizure disorders.

- It is usually preferable to treat ADHD first when there are comorbid conditions like anxiety and mood disorders. Treating ADHD can help decrease anxiety and lead to improvement of these co-morbid conditions.

- Response to stimulants can not be used as a diagnostic test because children without ADHD may respond to them.
• There have been reports of sudden death in adolescents taking mixed amphetamine salts. However, this is a rare occurrence. Baseline rate of sudden death in untreated adolescents is unknown but is considered very rare.

• Physicians should obtain a family history of sudden death or relevant cardiovascular conditions and perform a complete physical examinations. Systematic EKGs are not indicated.
STIMULANTS - SIDE EFFECTS

• Side effects related to the use of stimulants are not infrequent but are generally mild and benign.

• Side effects can often be managed by careful monitoring and by slight alterations in dosage and times given.

• Different stimulants have a different side-effect profile in each individual. Trying a different stimulant if the first one caused significant side effects often allows to achieve better control of symptoms and less side effects.

• The most common side effects of all the stimulant medications are anorexia, headache, and sleep disturbance.

• Less common side effects include dysphoria (in extreme and rare cases, psychotic symptoms), “over-focusing”, and tics.
STIMULANTS SIDE EFFECTS

- Decreased appetite
- Growth
- Sleep difficulties
- Irritability
- Emotionality
- Dullness
- Tics
- Headaches
- Stomachaches
Mechanism of Action of ADHD Medications

Stimulant
- Norepinephrine
- Dopamine
- Norepinephrine reuptake pump
- Dopamine reuptake pump
- Stimulant

Atomoxetine
- Norepinephrine
- Dopamine
- Norepinephrine reuptake pump
- Dopamine reuptake pump
- Atomoxetine

Presynaptic neuron
Postsynaptic neuron
HCN channels open

HCN channels are opened in the presence of cAMP, and the resulting current ‘shunts’ synaptic input.

HCN channels closed

Stimulation of α2A-adrenergic receptors by NA or guanfacine inhibits cAMP production, closing HCN channels and improving the efficiency of synaptic transmission.
<table>
<thead>
<tr>
<th>Medication Name</th>
<th>Frequency</th>
<th>Daily Dose Range</th>
<th>Maximum Dose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atomoxetine (Strattera) for children &lt;70 kg</td>
<td>Daily or twice daily</td>
<td>0.5-1.2 mg/kg/day</td>
<td>1.4 mg/kg/day</td>
</tr>
<tr>
<td>Atomoxetine (Strattera) for children ≥70 kg</td>
<td>Daily or twice daily</td>
<td>40-80 mg/day</td>
<td>100 mg/day</td>
</tr>
<tr>
<td>Clonidine ER (Kapvay)</td>
<td>Twice daily</td>
<td>0.1-0.4 mg/day</td>
<td>0.4 mg/day</td>
</tr>
<tr>
<td>Clonidine IR</td>
<td>Twice daily to 4 times a day</td>
<td>0.05-0.4 mg/day</td>
<td>0.4 mg/day</td>
</tr>
<tr>
<td>Guanfacine ER (Intuniv)</td>
<td>Daily</td>
<td>1-4 mg/day</td>
<td>4 mg/day</td>
</tr>
<tr>
<td>Guanfacine IR</td>
<td>Twice daily to 4 times a day</td>
<td>0.5-4 mg/day</td>
<td>4 mg/day</td>
</tr>
<tr>
<td>Imipramine (Tofranil)</td>
<td>Twice daily to 3 times a day</td>
<td>1-4 mg/kg/day</td>
<td>4 mg/kg/day or 200 mg/day, whichever is less</td>
</tr>
<tr>
<td>Desipramine (Norpramin)</td>
<td>Twice daily to 3 times a day</td>
<td>2-5 mg/kg/day</td>
<td>5 mg/kg/day</td>
</tr>
<tr>
<td>Nortriptyline (Pamelor)</td>
<td>Three to 4 times a day</td>
<td>0.5-2.0 mg/kg/day</td>
<td>2.0 mg/kg/day or 100 mg/day, whichever is less</td>
</tr>
<tr>
<td>Bupropion IR (Wellbutrin)</td>
<td>Daily to 3 times a day</td>
<td>50-100 mg</td>
<td>300 mg/day</td>
</tr>
<tr>
<td>Bupropion SR (Wellbutrin SR)</td>
<td>Twice daily</td>
<td>100-150 mg</td>
<td>300 mg/day</td>
</tr>
</tbody>
</table>

Source: References 5, 6.
NON-PHARMACOLOGICAL INTERVENTIONS

• Behavioral interventions

Parent training may have a positive effect on the behavior of children with ADHD. It may also reduce parental stress and enhance parental confidence. The literature evidence is not strong enough to form a basis for clinical practice guidelines.

• Psychotherapy – Cognitive Behavioral Therapy
• Executive function coaching
• Classroom accommodations
• Complementary alternative medicine
• Neurofeedback - also known as EEG Biofeedback
COUNSELING & BEHAVIORAL MANAGEMENT

• The intervention most frequently employed and with the strongest evidence for its efficacy is behavior modification training performed by the significant caretakers in the child’s environment.

• Techniques shown to be effective involve contingency reinforcement, including token economy, timeout, and response cost (earning or losing privileges).

• Parent training can be provided in different forms, depending on the severity of the behavioral problems.
PARENT TRAINING

• Providing clear commands and rules to the children and then keeping them aware of those rules.

• Providing positive attention and reinforcing the children for positive behaviors.

• Providing consequences and the removal of the positive attention for rule violations and inappropriate behaviors.
NUTRITIONAL SUPPLEMENTS & ADHD

• Two dietary supplements have strong supportive evidence of efficacy: Omega-3 fatty acids in treating ADHD symptoms and melatonin in treating sleep-onset insomnia in children with ADHD.

• Many other dietary and herbal supplements have widespread use in the United States for ADHD despite minimal evidence of efficacy.

• Ginko biloba and St John’s Wort, are fairly frequently used to treat ADHD despite nonexistent to negative evidence of efficacy and clear evidence for possible side effects.

• Clinicians should inquire about the use of dietary supplements.

• The efficacy of omega-3 fatty acids for ADHD appears well below the treatment gains achieved from traditional medications for ADHD.

• Melatonin is an excellent option to treat sleep problems in ADHD (stimulant-induced or not).
ADHD QUALITY IMPROVEMENT PRACTICE MODEL
ADHD GUIDELINES – AAP - 2011

• The PCC should initiate an ADHD evaluation for any child 4-18 years of age who presents with academic or behavioral problems and symptoms of inattention, hyperactivity and/or impulsivity.

• To make a diagnosis of ADHD the PCC should determine that DSM-IV criteria have been met, including documentation of impairment in more than one setting. Information should be obtained primarily from parents or guardians, teacher and other school and mental health clinicians involved in the child’s care. The PCC should also rule out any alternative cause.
• In the evaluation of a child for ADHD, the PCC should include assessment for co-morbid conditions including emotional or behavioral (eg, anxiety, depressive, oppositional defiant, and conduct disorders), developmental (eg, learning and language disorders or other neurodevelopmental disorders), and physical (eg, tics, sleep apnea) conditions.

• The primary care clinician should recognize ADHD as a chronic condition and treat patients accordingly.
• Recommendations for treatment of children and youth with ADHD vary depending on the patient’s age:

- For children 4–5 years of age, the PCC should prescribe parent and/or teacher-administered behavior therapy as the first line of treatment.

- For children 6–11 years of age, the PCC should prescribe US FDA–approved medications for ADHD and/or behavioral therapy, preferably both. The school environment, program, or placement is a part of any treatment plan.

- For adolescents 12–18 years of age, the PCC should prescribe US FDA–approved medications for ADHD and may prescribe behavioral therapy, preferably both.

• The primary care clinician should titrate doses of medication for ADHD to achieve maximum benefit with minimum adverse effects.
Well child visit & ADHD

• Elicit concerns about
  - Academic underachievement
  - Behavioral problems
  - Emotional challenges: anxiety, depression or mood dysregulation symptoms
  - Social difficulties.
ASSESSMENT VISIT

• Review parental and teachers behavioral questionnaires.

• Review report cards, standardized testing, IEP

• Interview parent and child to confirm/clarify/expand patient history.

• In case of doubt you can always consider calling the teacher.

• Consider referral for psychological evaluation and/or counseling.

• Consider referral to child psychiatrist or developmental behavioral pediatrician.
FEEDBACK VISIT

• Plan additional time to explain the ADHD diagnosis and treatment plan.

• Make sure to understand the parents perspective and try to address their concerns.

• Discuss treatment goals.

• Make recommendations about classroom placement (504 plan) and additional services (OT, counseling, behavioral interventions, parenting).

• Explain the benefit and potential side effects of pharmacologic interventions.

• Be available for additional questions or concerns about side effects.

• Schedule a follow up visit in the next 4-6 weeks.
FOLLOW UP VISITS

• Check weight, height, BP
• Go over treatment goals
• Use teacher behavioral questionnaires as needed
• Assess areas that can be affected by ADHD: academic performance, behavioral, emotional well being and social functioning
• Review and manage side effects.
• Review and manage comorbidities
QUALITY IMPROVEMENT GOALS FOR THE PRIMARY CARE PHYSICIAN

• Increase the use of the DSM5 criteria to evaluate ADHD status.

• Increase the use of a standardized ADHD parent and teacher ratings at initial diagnosis.

• Schedule a follow up visit within the next 2 weeks.

• 4 and 5 year olds diagnosed with ADHD should be referred for behavioral treatment before starting ADHD medication treatment.

• Provide a written care management plan to the parents of children with ADHD.
RESOURCES FOR FAMILIES

• National Institute of Mental Health. What is attention deficit hyperactivity disorder (ADHD, ADD)?


• National Resource Center on AD/HD. Managing medication for children and adolescents with ADHD.

  National Resource Center on AD/HD. Managing medication for children and adolescents with ADHD.
RESOURCES FOR PHYSICIANS/CLINICIANS

• ADHD Toolkit
  www.nichq.org/adhd_tools.html#adhd_parent

• www.CHADD.org. Children and Adults with Attention Deficit Hyperactivity Disorder

• Healthy Children – the American Academy of Pediatrics’ website for parents –
  www.healthychildren.org/English/health-issues/conditions/adhd/pages/What-You-Need-to-Know-About-ADHD.aspx

• National Resource Center (NRC) on ADHD – CDC.
  www.help4adhd.org
SPARK
Help Speed Up Autism Research
For further information

- Contact: Hai Li
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QUESTION

An 8-year old boy is inattentive at home and school, has difficulty completing his homework, and is failing reading. Physical examination findings are normal, he has friends at school, and the family has been living in their newly built home for the past 3 years. You begin to discuss a diagnosis of attention-deficit/hyperactivity disorder, and his mother asks you what tests you will perform to try to determine the cause of the problem.

Of the following, your BEST response is that you will order:

A. a lead level
B. an electroencephalogram
C. computed tomography scan of the brain
D. no tests at this time
E. thyroid studies
QUESTION

A 14-year-old boy was diagnosed with ADHD at age 7. Although he continues to have some difficulty with inattention in class, he has responded well to stimulant medications. His mother would like to Know what to expect as her son enters adulthood. Of the following, your BEST response is that adults who have a history of ADHD in childhood

A. are at increased risk of substance abuse
B. have a paradoxical response to stimulant medications
C. have educational outcomes similar to adults who do not have a history of ADHD
D. have motor signs (hyperactivity) that remain prominent in adulthood.
E. have similar symptoms in adulthood as they did in childhood
QUESTION

You diagnose attention-deficit/hyperactivity disorder in a 10-year old boy and recommend treatment with methylphenidate. His mother asks about adverse effects of the treatment.

Of the following, the MOST common adverse effect of treatment is:

a. delayed sleep onset
b. depression
c. hallucinations
d. tics
e. weight gain