# HarmonYX® Test for ADHD

## WHAT CAN THE TEST TELL US?

The **Harmonyx® Test for ADHD** examines the effects of the patient's genotype on the metabolism and efficacy of the medications listed below using the following genes: **CYP2B6**, **CYP2D6**, **ADRA2A**, and **COMT**.

The Harmonyx® Test for ADHD tests for the following medications:

- amphetamine salts
  Adderall®
- atomoxetine
  Strattera®
- bupropion
  Wellbutrin®, Budeprion®, Burpoban®, Forfivo®
- clonidine
  Catapres®, Kapvay®
- dexmethylphenidate
  Focalin®
- dextroamphetamine
  Dexedrine®, ProCentra®, Zenzedi®
- guanfacine
  Intuniv®, Tenex®
- lisdexamfetamine
  Vyvanse®
- methylphenidate
  Concerta®, Daytrana®, Metadate®, Methylin®, Quillivant™, Ritalin®

To help you effectively weigh the pros and cons of each medication, our test results are color-coded to tell you exactly what you need to know:

**Try these prescriptions first**
**(use as directed)**

**Try these prescriptions next**
**(use with monitoring)**

**Try these prescriptions last**
**(use with close monitoring)**

### Examining Both Pharmacodynamics and Pharmacokinetic Genes

The test provides genotypes for ADRA2A and COMT, two *pharmacodynamic* genes which have been implicated in the therapeutic response of patients taking stimulant medications (amphetamines and methylphenidate), as well as the alpha-2 adrenergic receptor blockers (guanfacine and clonidine). It also examines two key *pharmacokinetic* genes implicated in ADHD treatment; CYP2B6 is responsible for the metabolism of the most active metabolite of bupropion (Wellbutrin®), while CYP2D6 genotype has been shown to have a significant effect on the body's ability to metabolize atomoxetine (Strattera®).[1,2,3]

### Genetic variations can alter the patient's response to medications.

- Patients with genetic variations that either impair their ability to metabolize a medication, or impede the intended pharmacodynamic action of the medication, are likely to show a reduced response to the drug in question.
- The degree of impaired response to the medication in question is generally dependent on the number of variant alleles in the patient's genotype (the gene-dose effect).

# WHY IS TESTING IMPORTANT?

## ADHD is prevalent, and medication problems are common.

ADHD is the most common neurodevelopmental disorder of childhood, with more than 1 in 10 school-aged children in the US receiving an ADHD diagnosis in 2011.[4]

- The disorder is caused by a complex genetic mechanism and is likely the result of the combined actions of several genes.[5] ADHD is highly heritable—with 70-80% of cases thought to be genetic in origin, rather than due to environmental factors (such as maternal alcohol use in pregnancy).[6]
- The percentage of children taking medications for ADHD increased by 28% between 2007 and 2011.
- Treatment failure and side effects are key contributors to the pervasive difficulty in adhering to pharmacologic therapy in ADHD patients.[4]
- The average treatment duration on a given medication is around 2 years, with over two thirds of patients stopping treatment with a previously effective medication by this point; in patients who continue taking medication, treatment is no longer associated with better outcomes by the end of 24 months.[7]
- Treatment failures and medication discontinuation become more concerning when one considers that young individuals with untreated ADHD are more likely not only to experience educational and social disadvantages (i.e. poorer academic performance and criminal detention), but also to have increased risk of subsequent health problems.[8]

**"When a psychotropic medication is necessary, families, children, and their prescribing clinicians naturally are motivated to identify the 'right medication' from the very first prescription." [9]**

# WHO SHOULD BE TESTED?

- **Initial Diagnosis of ADHD**: Patients with a new or recent ADHD diagnosis may benefit from the test by using the results as guidance for initial therapy (in cooperation with their prescribing physician).
- **Current ADHD Treatment No Longer Effective**: Given the evidence surrounding treatment failure and patient adherence, patients with a current prescription that is no longer working may need to be tested in order to determine a more effective treatment option.
- **Stimulant Alternative**: Due to concerns over abuse and potential side effects, some patients and their parents prefer a non-stimulant alternative. The Harmonyx Test for ADHD can help guide these treatment decisions, and can highlight the alternative treatment that may be the most appropriate for the patient's genetic profile.


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[2]Hamidovic, A et al. (2010). Catechol-O-methyltransferase val158met genotype modulates sustained attention in both the
[3]Da Silva, TL et al. (2008). Adrenergic alpha2A receptor gene and response to methylphenidate in attention-deficit/hyperactivity disorder- predominantly inattentive type. J Neural Transm, 115(2): 341-345.
[4]Visser S, Danielson M, Bitsko R, et al. (2013). Trends in the Parent-Report of Health Care Provider-Diagnosis and Medication Treatment for ADHD disorder: United States, 2003–2011. J Am Acad Child Adolesc Psychiatry. Published online ahead of print.[5]Buckstein, O. Adult attention deficit hyperactivity disorder: Epidemiology, pathogenesis, clinical features, course, assessment, and diagnosis. In: UpToDate, Brent, D. (Ed), UpToDate, Waltham, MA. (Accessed on November 10, 2014.)
[6]Geissler, J and Lesch, K (2011). A lifetime of attention-deficit/hyperactivity disorder: diagnostic challenges, treatment, and neurobiological mechanisms. Expert Rev Neurother, 11(10): 1467-1484.
[7]Krull, K. Attention deficit hyperactivity disorder in children and adolescents: Epidemiology and pathogenesis. In: UpToDate, Augastyn, M (Ed), UpToDate, Waltham, MA. (Accessed on November 5, 2014.)
[8]Chen, C. et al. (2011). Differential effects of predictors on methylphenidate initiation and discontinuation among young people with newly diagnosed attention-deficit/hyperactivity disorder. Journal of Child and Adolescent Psychopharmacology, 21(3): 265-273.
[9]Wall, C et al. (2012). Psychiatric pharmacogenomics in pediatric psychopharmacology. Child Adolesc Psychiatric Clin N Am 21, 773-788.