Your Genes and Your Health
http://bio84.stanford.edu/

Diseases and Disease Databases

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Stanford at The Tech: Understanding Genetics

http://genetics.thetech.org/
Genomics as the Basis of Preventive Medicine

• If we know the gene that causes an inherited disease

• And we know the function of that gene

• Then we can understand the cause of the disease at the molecular level,

• This knowledge permits development of better diagnoses, treatments, drugs, therapies and other interventions to cure the disease.
Where would you go for information on inherited diseases?

- Google or Google Scholar?
- National Center for Biotechnology Information
- Genes and Disease
- Genetics Home Reference
- Medline Plus
- Gene Reviews
- Online Mendelian Inheritance in Man (OMIM)
- MedGen – human medical genetics
- PubMed Keywords or PubMed MeSh search?
- PubMed Central
- PubMed Health
- Clinical Trials Database
NCBI: Genetics and Medicine

Databases

Books
A collection of biomedical books that can be searched directly or from linked data in other NCBI databases. The collection includes biomedical textbooks, other scientific titles, genetic resources such as GeneReviews, and NCBI help manuals.

ClinVar
A resource to provide a public, tracked record of reported relationships between human variation and observed health status with supporting evidence. Related information in the NIH Genetic Testing Registry (GTR), MedGen, Gene, OMIM, PubMed and other sources is accessible through hyperlinks on the records.

Clinical Trials.gov
A registry and results database of publicly- and privately-supported clinical studies of human participants conducted around the world.

Database of Genotypes and Phenotypes (dbGaP)
An archive and distribution center for the description and results of studies which investigate the interaction of genotype and phenotype. These studies include genome-wide association (GWAS), medical resequencing, molecular diagnostic assays, as well as association between genotype and non-clinical traits.

Database of Major Histocompatibility Complex (dbMHC)
An open, publicly accessible platform where the HLA community can submit, edit, view, and exchange data related to the human major histocompatibility complex. It consists of an interactive Alignment Viewer for HLA and related genes, an MHC microsatellite database, a sequence interpretation site for Sequencing Based Typing (SBT), and a Primer/Probe database.

Gene
A searchable database of genes, focusing on genomes that have been completely sequenced and that have an active research community to contribute gene-specific data. Information includes nomenclature, chromosomal localization, gene products and their attributes (e.g., protein interactions), associated markers, phenotypes, interactions, and links to citations, sequences, variation details, maps, expression reports, homologs, protein domain content, and external databases.

GeneReviews
A collection of expert-authored, peer-reviewed disease descriptions on the NCBI Bookshelf that apply genetic testing to the diagnosis, management, and genetic counseling of patients and families with specific inherited conditions.

Genes and Disease
Summaries of information for selected genetic disorders with discussions of the underlying mutation(s) and clinical features, as well as links to related databases and organizations.
MedGen
A portal to information about medical genetics. MedGen includes term lists from multiple sources and organizes them into concept groupings and hierarchies. Links are also provided to information related to those concepts in the NIH Genetic Testing Registry (GTR), ClinVar, Gene, OMIM, PubMed, and other sources.

NCBI Pathogen Detection Project
A project involving the collection and analysis of bacterial pathogen genomic sequences originating from food, environmental and patient isolates. Currently, an automated pipeline clusters and identifies sequences supplied primarily by public health laboratories to assist in the investigation of foodborne disease outbreaks and discover potential sources of food contamination.

Online Mendelian Inheritance in Man (OMIM)
A database of human genes and genetic disorders. NCBI maintains current content and continues to support its searching and integration with other NCBI databases. However, OMIM now has a new home at omim.org, and users are directed to this site for full record displays.

PubMed
A database of citations and abstracts for biomedical literature from MEDLINE and additional life science journals. Links are provided when full text versions of the articles are available via PubMed Central (described below) or other websites.

PubMed Central (PMC)
A digital archive of full-text biomedical and life sciences journal literature, including clinical medicine and public health.

PubMed Health
A collection of clinical effectiveness reviews and other resources to help consumers and clinicians use and understand clinical research results. These are drawn from the NCBI Bookshelf and PubMed, including published systematic reviews from organizations such as the Agency for Health Care Research and Quality, The Cochrane Collaboration, and others (see complete listing). Links to full text articles are provided when available.
Genes and Disease

Genes and Disease is a collection of articles that discusses genes and the diseases that they cause. These genetic disorders are organized by the parts of the body that they affect. As some diseases affect various body systems, they appear in more than one chapter.

With each genetic disorder, the underlying mutation(s) is discussed, along with clinical features and links to key websites.

Contents

- Introduction to Genes and Disease
- Blood and Lymph Diseases
- Cancers
- The Digestive System
- Ear, Nose, and Throat
- Diseases of the Eye
- Female-Specific Diseases
- Glands and Hormones
- The Heart and Blood Vessels
Huntington disease

Huntington disease (HD) is an inherited, degenerative neurological disease that leads to dementia. About 30,000 Americans have HD and about 150,000 more are at risk of inheriting the disease from a parent.

The HD gene, whose mutation results in Huntington disease, was mapped to chromosome 4 in 1983 and cloned in 1993. The mutation is a characteristic expansion of a nucleotide triplet repeat in the DNA that codes for the protein huntingtin. As the number of repeated triplets - CAG (cytosine, adenine, guanine) - increases, the age of onset in the patient decreases. Furthermore, because the unstable trinucleotide repeat can lengthen when passed from parent to child, the age of onset can decrease from one generation to the next. Since people who have those repeats always suffer from Huntington disease, it suggests that the mutation causes a gain-of-function, in which the mRNA or protein takes on a new property or is expressed inappropriately.

Related diseases

See other Diseases of the Nervous System
Genetics Home Reference
What is Huntington disease?

Huntington disease is a progressive brain disorder that causes uncontrolled movements, emotional problems, and loss of thinking ability (cognition).

Adult-onset Huntington disease, the most common form of this disorder, usually appears in a person's thirties or forties. Early signs and symptoms can include irritability, depression, small involuntary movements, poor coordination, and trouble learning new information or making decisions. Many people with Huntington disease develop involuntary jerking or twitching movements known as chorea. As the disease progresses, these movements become more pronounced. Affected individuals may have trouble walking, speaking, and swallowing. People with this disorder also experience changes in personality and a decline in thinking and reasoning abilities. Individuals with the adult-onset form of Huntington disease usually live about 15 to 20 years after signs and symptoms begin.

A less common, early-onset form of Huntington disease begins in childhood or adolescence. It also involves movement problems and mental and emotional changes. Additional signs of the early-onset form include slow movements, clumsiness, frequent falling, rigidity, slurred speech, and drooling. School performance often declines as thinking and reasoning abilities become impaired. Seizures occur in 30 percent to 50 percent of children with this condition. Early-onset Huntington disease tends to progress more quickly than the adult-onset form; affected individuals usually live 10 to 15 years after signs and symptoms appear.

How common is Huntington disease?

Huntington disease affects an estimated 3 to 7 per 100,000 people of European ancestry. The disorder appears to be less common in some other populations, including people of Japanese, Chinese, and African descent.
What is the official name of the HTT gene?

The official name of this gene is “huntingtin.”

HTT is the gene's official symbol. The HTT gene is also known by other names, listed below. Read more about gene names and symbols on the About page.

What is the normal function of the HTT gene?

The HTT gene provides instructions for making a protein called huntingtin. Although the exact function of this protein is unknown, it appears to play an important role in nerve cells (neurons) in the brain and is essential for normal development before birth. Huntingtin is found in many of the body’s tissues, with the highest levels of activity in the brain. Within cells, this protein may be involved in chemical signaling, transporting materials, attaching (binding) to proteins and other structures, and protecting the cell from self-destruction (apoptosis).

One region of the HTT gene contains a particular DNA segment known as a CAG trinucleotide repeat. This segment is made up of a series of three DNA building blocks (cytosine, adenine, and guanine) that appear multiple times in a row. Normally, the CAG segment is repeated 10 to 35 times within the gene.
Newborn Screening

Newborn screening is the practice of testing all babies for certain disorders and conditions that can hinder their normal development. Babies with these conditions appear healthy at birth but can develop serious medical problems later in infancy or childhood. Early detection and treatment can help prevent intellectual and physical disabilities and life-threatening illnesses.

Newborn screening usually begins with a blood test 24 to 48 hours after the baby is born. The test is performed by pricking the baby's heel to collect a few drops of blood. The blood is placed on a special piece of paper and sent to a laboratory for analysis. Parents can ask for a copy of the test results, which are sent to the baby's doctor or clinic.

Sometimes a repeat blood test is required, particularly if the first test was done before the baby was 24 hours old. If the results of the test are abnormal, additional testing is required to confirm the result. Parents are notified within a few days of the first test if retesting is necessary. The blood test should be repeated as soon as possible.

Newborn screening varies from state to state. All states must screen for at least 21 disorders by law, and some states test for 30 or more. Parents can ask their doctor about expanded (supplemental) screening if they live in an area that screens for a limited number of disorders.

To encourage uniform and comprehensive newborn screening throughout the United States, the Health Resources and Services Administration (HRSA) issued a report that recommends screening for 29 specific conditions. The recommendations include a test for hearing loss in newborns. The hearing test uses a soft earphone or other instrument that is placed in the baby's ear.

Please use the links below to learn more about newborn screening.

- Description of disorders detected through newborn screening (Genetics Home Reference)
- Newborn screening resources (U.S. National Library of Medicine)
- Frequently Asked Questions about Newborn Bloodspot Screening (National Newborn
Help Me Understand Genetics presents basic information about genetics in clear language and provides links to online resources.

Table of Contents

Cells and DNA
- Cells, genes, and chromosomes

How Genes Work
- Proteins, cell growth, and cell division

Mutations and Health
- Gene mutations, chromosomal changes, and conditions that run in families

Inheriting Genetic Conditions
- Inheritance patterns and understanding risk

Genetics and Human Traits
- How genes influence various human characteristics

Genetic Consultation
- Finding and visiting a genetic counselor or other genetics professional

Genetic Testing
- Benefits, costs, risks, and limitations of genetic testing

Newborn Screening
- Testing all babies in their first days of life for certain disorders and conditions

Gene Therapy
- Experimental techniques, safety, ethics, and availability

The Human Genome Project
- Sequencing and understanding the human genome

Genomic Research
- Next steps in studying the human genome

Precision Medicine
- Disease treatment and prevention strategies tailored to variability in genes, environment, and lifestyle

Most Popular Handbook pages

1. What is DNA?
2. What are proteins and what do they do?
3. How many chromosomes do people have?
4. What is a gene mutation and how do mutations occur?
5. What kinds of gene mutations are possible?

Illustrations
Huntington disease

Huntington disease is a disorder in which nerve cells in certain parts of the brain waste away, or degenerate. The disease is passed down through families.

Causes

Huntington disease is caused by a genetic defect on chromosome 4. The defect causes a part of DNA, called a CAG repeat, to occur many more times than it is supposed to. Normally, this section of DNA is repeated 10 to 28 times. But in persons with Huntington disease, it is repeated 36 to 120 times.

As the gene is passed down through families, the number of repeats tend to get larger. The larger the number of repeats, the higher your chance of developing symptoms at an earlier age. Therefore, as the disease is passed along in families, symptoms develop at younger and younger ages.

There are two forms of Huntington disease.

- Adult-onset Huntington disease is the most common. Persons with this form usually develop symptoms in their mid 30s and 40s.
- Early-onset Huntington disease affects a small number of cases and begins in childhood or the teens.

If one of your parents has Huntington disease, you have a 50% chance of getting the gene. If you get the gene from your parents, you can also pass it on to your children, who will also have a 50% change of getting the gene. If you do not get the gene from your parents, you cannot pass the gene on to your children.
Drugs, Supplements, and Herbal Information

Drugs
Learn about your prescription drugs and over-the-counter medicines. Includes side effects, dosage, special precautions, and more.

Browse by generic or brand name

A B C D E F G H I J K L M N O P Q R S T U V W X Y Z 0-9

For FDA approved labels included in drug packages, see DailyMed.

Herbs and Supplements
Browse dietary supplements and herbal remedies to learn about their effectiveness, usual dosage, and drug interactions.

All herbs and supplements
Videos & Cool Tools

Learn by watching health videos on topics such as human anatomy, surgical procedures and health news. Test your knowledge with the interactive tutorials and games. Check your health by using the calculators and quizzes.

Coffee and Skin Cancer Risk

View latest news

Search all Videos & Tutorials
Huntington Disease Gene Review

**GeneReviews** [Internet].
Pagon RA, Bird TC, Doolan CR, et al., editors.
Seattle (WA): University of Washington, Seattle; 1993–
[Table of Contents Page]

**In this GeneReview**
- Summary
- Diagnosis
- Clinical Description
- Differential Diagnosis
- Management
- Genetic Counseling
- Molecular Genetics
- Resources
- References
- Chapter Notes

**GeneReviews Links**
- GeneTests Home Page
- GeneReviews Advanced Search
- About GeneTests

### Huntington Disease

**Huntington Chorea**

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**Summary**

Go to:  

Disease characteristics. Huntington disease (HD) is a progressive disorder of motor, cognitive, and psychiatric disturbances. The mean age of onset is 35 to 44 years and the median survival time is 15 to 18 years after onset.

Diagnosis/testing. The diagnosis of HD rests on positive family history, characteristic clinical findings, and the detection of an expansion of 36 or more CAG trinucleotide repeats in *HTT*.

Management. Treatment of manifestations: pharmacologic therapy including typical neuroleptics (haloperidol), atypical neuroleptics (risperidone, aripiprazole), and mood stabilizers (valproate, lithium, carbamazepine). Treatment of complications: oxygen therapy or surgery may be necessary for obstructive sleep apnea. For patients with severe manifestations, consideration of neurosurgical treatments (and thalamic毁损) may be considered. Genetic counseling is essential for patients and families to understand their genetic risk and for the management of the disease in affected individuals.
### Huntington disease

**Lab:** Molecular Diagnostic Laboratory Diagnostic Services of Manitoba, Health Sciences Centre site Winnipeg, Manitoba, Canada

<table>
<thead>
<tr>
<th>Condition</th>
<th>Test target</th>
<th>Methods</th>
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<td>Huntington's chorea</td>
<td>HTT</td>
<td>T Targeted variant analysis</td>
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### Huntington's Disease

**Lab:** Molecular Pathology Laboratory Ohio State University Columbus, Ohio, United States

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### Huntington's Disease

**Lab:** Center for Human Genetics, Inc Cambridge, Massachusetts, United States

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### Huntington Disease

**Lab:** Knight Diagnostic Laboratories - Molecular Diagnostic Center Oregon Health and Science University Portland, Oregon, United States

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<th>Methods</th>
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<tbody>
<tr>
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<td>HTT</td>
<td>T Targeted variant analysis</td>
</tr>
</tbody>
</table>
HTT huntingtin [Homo sapiens]

Gene ID: 3064, updated on 3-Jan-2011

Summary

Huntingtin is a disease gene linked to Huntington’s disease, a neurodegenerative disorder characterized by loss of striatal neurons. This is thought to be caused by an expanded, unstable trinucleotide repeat in the huntingtin gene, which translates as a polyglutamine repeat in the protein product. A fairly broad range in the number of trinucleotide repeats has been identified in normal controls, and repeat numbers in excess of 40 have been described as pathalogical. The huntingtin locus is large, spanning 180 kb and consisting of 67 exons. The huntingtin gene is widely expressed and is required for normal development. It is expressed as 2 alternatively polyadenylated forms displaying different relative abundance in various fetal and adult tissues. The larger transcript is approximately 13.7 kb and is expressed predominantly in adult and fetal brain whereas the smaller transcript of approximately 10.3 kb is more widely expressed. The genetic defect leading to Huntington’s disease may not necessarily eliminate transcription, but may confer a new property on the mRNA or alter the function of the protein. One candidate is the huntingtin-associated protein-1, highly expressed in brain, which has increased affinity for huntingtin protein with expanded polyglutamine repeats. This gene contains an upstream open reading frame in the 5' UTR that inhibits expression of the huntingtin gene product through translational repression. [provided by RefSeq]
Huntington Disease Protein Sequence

RecName: Full=Huntingtin; AltName: Full=Huntington disease protein; Short=HD protein
Swiss-Prot: P42858.2
GenPept

>gll296434520|sp|P42858.2|H_HUMAN RecName: Full=Huntingtin; AltName: Full=Huntington disease protein; Short=HD protein
MATLEKLMKAE5LKSFQOQQQQQQQQQQQQQQQQQPPPPPPPPPQPLQPQPQAPQLPQPQPPP
PPPPPPPPAAYEEPLHRPKKELSATKDRVNHCLTICENIVAOSVRNPEFQKLLGIAMEFLCLCCL
HRAKLPRLPYLQLPRLQLELYKCIKKGAPRSLRAALWRFAELALHLRPRKCPYLVNL
PCLTRTSKRPPESSQQETLAAAPKIMA5GFNPANDNETKVLKIAFIANLKSSSPTIRRTAAGSAYVICOH
SRRTQYFLSWLLNLVLLGPPVPDEHSTLTLILRLYRPLPQLQKVSXTLSKLGSGFVTREMEVSPS
AEQLVQYVELLTHHTQGHDHNVTGAELLQLFRTPPEPQTTQTLTVGGIGQLTAAKEESSGGRSRSRS
VELTAAGGGSSCSPYLSRQKQGKLVEGEAALDDSESRSQVSSSALTASVKEISGELASSSVGSTPCGA
GHIIETEQPRSHQTLQADSDVADSCDLDSSATTDGEEDEILSLLSQQVSAYPSPDAMNLDGTQASSPSD
SSQTTEGPDSAVTPSDSSEIVLDGTNQYLLGQIQQPDQDEEDEATGLPDASEAFRNSMALQAHLL
KNMHCQRSPPDSVYKDFVLREDATEPGQDQHMPKCRKGDIGQTIDDSAPLVHCVRLSASSFLNTGKNV
LVPPDDRVRSYKALALSVCVGAAILAHPESF5SKLYKVPDTTETYPEEYQVSILDLYNIDHDGPQVRGATAI
LCGLTICSLSR5SFHVDDMNQIERTLTGNTFSLADCPL1LRKTLKDESSVTCKLACTAVRCVNSLCCS
SYSEGILQLQIDVTLRNSSYNVRLTETLAEIDFRVLSFLEKAEHNLHRAHMYTGLKLERVNN
VVLHHLGGDEPRVHAAASLRLVPLKFYKCQDGQAOQPDDEAWRDQSSYKLMLMHTQPPSHFSVSTI
TRHGYQNLSTVDTMENLSRSVIAAYAVLHILLSTTRALTGGCEALCLLSTASFPCIVSWLWCHGV
PLSASDE5RSKCTYGMATMILLLLLSAWPPLDLSAHQDALILALNLLAASAQPCKLRS5SWASEEANPAAAT
KQEEVWPALGDRALVMQEVLSFLHLLKVINACHVLDVAPGAIKAAFLPSLTNPSSPSRIIRGKEKEP
Age of Onset and Repeat Length

The graph illustrates the relationship between the mean age of onset (years) and the CAG repeat size. As the CAG repeat size increases, the mean age of onset decreases, indicating a correlation between the two variables.
Huntington Disease can Arise from Unequal Crossing Over During Meiosis

- Crossing over between maternal and paternal chromosomes

- Unequal crossing over between maternal and paternal chromosomes
Trinucleotide repeat disorders (also known as trinucleotide repeat expansion disorders, triplet repeat expansion disorders or codon reiteration disorders) are a set of genetic disorders caused by trinucleotide repeat expansion, a kind of mutation where trinucleotide repeats in certain genes exceed the normal, stable threshold, which differs per gene. The mutation is a subset of unstable microsatellite repeats that occur throughout all genomic sequences. If the repeat is present in a healthy gene, a dynamic mutation may increase the repeat count and result in a defective gene.

This article needs additional citations for verification. Please help improve this article by adding citations to reliable sources. Unsourced material may be challenged and removed. (December 2011)
# Trinucleotide Repeat Disorders


## Polyglutamine (PolyQ) Diseases

<table>
<thead>
<tr>
<th>Type</th>
<th>Gene</th>
<th>Normal PolyQ repeats</th>
<th>Pathogenic PolyQ repeats</th>
</tr>
</thead>
<tbody>
<tr>
<td>DRPLA (Dentatorubropallidoluysian atrophy)</td>
<td>ATN1 or DRPLA</td>
<td>6 - 35</td>
<td>49 - 88</td>
</tr>
<tr>
<td>HD (Huntington's disease)</td>
<td>HTT (Huntingtin)</td>
<td>6 - 35</td>
<td>36 - 250</td>
</tr>
<tr>
<td>SBMA (Spinal and bulbar muscular atrophy)</td>
<td>AR</td>
<td>9 - 36</td>
<td>38 - 62</td>
</tr>
<tr>
<td>SCA1 (Spinocerebellar ataxia Type 1)</td>
<td>ATXN1</td>
<td>6 - 35</td>
<td>49 - 88</td>
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<tr>
<td>SCA2 (Spinocerebellar ataxia Type 2)</td>
<td>ATXN2</td>
<td>14 - 32</td>
<td>33 - 77</td>
</tr>
<tr>
<td>SCA3 (Spinocerebellar ataxia Type 3 or Machado-Joseph disease)</td>
<td>ATXN3</td>
<td>12 - 40</td>
<td>55 - 86</td>
</tr>
<tr>
<td>SCA6 (Spinocerebellar ataxia Type 6)</td>
<td>CACNA1A</td>
<td>4 - 18</td>
<td>21 - 30</td>
</tr>
<tr>
<td>SCA7 (Spinocerebellar ataxia Type 7)</td>
<td>ATXN7</td>
<td>7 - 17</td>
<td>38 - 120</td>
</tr>
<tr>
<td>SCA17 (Spinocerebellar ataxia Type 17)</td>
<td>TBP</td>
<td>25 - 42</td>
<td>47 - 63</td>
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</table>
# Trinucleotide Repeat Disorders


## Non-Polyglutamine Diseases

<table>
<thead>
<tr>
<th>Type</th>
<th>Gene</th>
<th>Codon</th>
<th>Normal/wild type</th>
<th>Pathogenic</th>
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<tbody>
<tr>
<td>FRAXA (Fragile X syndrome)</td>
<td><em>FMR1</em>, on the X-chromosome</td>
<td>CGG</td>
<td>6 - 53</td>
<td>230+</td>
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<tr>
<td>FXTAS (Fragile X-associated tremor/ataxia syndrome)</td>
<td><em>FMR1</em>, on the X-chromosome</td>
<td>CGG</td>
<td>6 - 53</td>
<td>55-200</td>
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<tr>
<td>FRAXE (Fragile XE mental retardation)</td>
<td><em>AFF2</em> or <em>FMR2</em>, on the X-chromosome</td>
<td>CCG</td>
<td>6 - 35</td>
<td>200+</td>
</tr>
<tr>
<td>FRDA (Friedreich's ataxia)</td>
<td><em>FXN</em> or X25, (frataxin—reduced expression)</td>
<td>GAA</td>
<td>7 - 34</td>
<td>100+</td>
</tr>
<tr>
<td>DM (Myotonic dystrophy)</td>
<td><em>DMPK</em></td>
<td>CTG</td>
<td>5 - 37</td>
<td>50+</td>
</tr>
<tr>
<td>SCA8 (Spinocerebellar ataxia Type 8)</td>
<td><em>OSCA</em> or <em>SCA8</em></td>
<td>CTG</td>
<td>16 - 37</td>
<td>110 - 250</td>
</tr>
<tr>
<td>SCA12 (Spinocerebellar ataxia Type 12)</td>
<td><em>PPP2R2B</em> or <em>SCA12</em></td>
<td>nnn On 5' end</td>
<td>7 - 28</td>
<td>66 - 78</td>
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Huntington Outreach Project at Stanford

http://web.stanford.edu/group/hopes/cgi-bin/hopes_test/

Figure S-3: CAG Repeat Counts on the Huntington gene

Genetic test results correspond to the ranges of the CAG repeat site.

- Negative test result: less than 35 CAG repeats
- Uninformative test result: 36-39 CAG repeats
- Positive test result: more than 40 CAG repeats

The HOPES Brain Tutorial
Cerebral Cortex

Genetic Testing

TRiC and Huntington Protein Aggregation

Trojan Therapy
The Science Behind Trojan Therapy
Other neurodegenerative disorders

Trinucleotide Repeat Disorders

By Stephanie Liou  26 Jun, 2010  Other neurodegenerative disorders

When the cause of a disease can be traced to having too many copies of a certain nucleotide triplet in the DNA, the disease is said to be a trinucleotide repeat disorder. Today, there are 14 documented trinucleotide repeat disorders that affect human beings.

Huntington's Disease is part of this group.

Some of these 14 trinucleotide repeat disorders are more alike than others. While the symptoms and the affected body parts vary by disease, scientists consider two illnesses to be similar if they share the same repeated codon as their cause. Six of the 14 trinucleotide repeat disorders have little or no apparent similarity to each other, or to the 8 remaining diseases. These 6 are described in brief at the end of this section. The 8 remaining disorders, one of which is Huntington's Disease, all share the same repeated codon as their cause: CAG. Since CAG codes for an amino acid called glutamine, these 8 trinucleotide repeat disorders are also called glutamine repeat disorders.
### Huntington Disease Clinical Trials

Hereditary Contraction of the Brain and Nervous System

**Find Studies > Search Results**

156 studies found for: Huntington Disease | Open Studies

**Modify this search** | **How to Use Search Results**

#### Include only open studies

**Show Display Options**

<table>
<thead>
<tr>
<th>Rank</th>
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<tbody>
<tr>
<td>1</td>
<td>Recruiting</td>
<td>Study of Huntington Patients in Connection With European Huntington's Disease Network (EHDN)</td>
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<td></td>
<td></td>
<td>Condition: Huntington Disease</td>
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<tr>
<td>2</td>
<td>Recruiting</td>
<td>REGISTRY - an Observational Study of the European Huntington's Disease Network (EHDN)</td>
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<td></td>
<td>Conditions: Huntington Disease, Huntington's Disease</td>
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<tr>
<td>3</td>
<td>Recruiting</td>
<td>Brain Structure and Function in Children at Risk for Huntington's Disease</td>
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<td>Condition: Huntington's Disease</td>
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<td>4</td>
<td>Recruiting</td>
<td>A Phase 2, to Evaluating the Safety and Efficacy of Pridopidine Versus Placebo for Symptomatic Treatment in Patients With Huntington's Disease</td>
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<tr>
<td></td>
<td></td>
<td>Condition: Huntington's Disease</td>
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Intervention:

- Drug: Pridopidine; Other: Placebo
Registered Studies in Clinical Trials

https://clinicaltrials.gov/ct2/resources/trends
Cystic Fibrosis

- Autosomal (chromosome 7q31.2) recessive.
- Inhibits many bodily secretions
  - Pancreatic digestive enzymes
  - Sweat glands
  - Lung mucosa in alveoli and bronchi
  - Infertility in males (>97%)
  - Cirrhosis of the liver
  - Hepatic steatosis
- Caused by mutations in the CFTR gene that encodes a chloride ion channel that pumps chloride ion and water out of cells.
Cystic Fibrosis

Cystic fibrosis is a hereditary disorder characterized by lung congestion and infection and malabsorption of nutrients by the pancreas.

Mucus blocks air sacs (alveoli) in the lungs.

Mucus blocks pancreatic ducts.
CFTR is a chloride/water ion channel or pore
# Mutations Causing Cystic Fibrosis

<table>
<thead>
<tr>
<th>Mutation</th>
<th>Relative Frequency</th>
<th>Mutation Functional Class ¹</th>
<th>Population Group</th>
<th>Approximate Carrier Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>ΔF508</td>
<td>66.0%</td>
<td>II</td>
<td></td>
<td></td>
</tr>
<tr>
<td>G542X</td>
<td>2.4%</td>
<td>I</td>
<td></td>
<td></td>
</tr>
<tr>
<td>G551D</td>
<td>1.6%</td>
<td>III</td>
<td></td>
<td></td>
</tr>
<tr>
<td>N1303Lys</td>
<td>1.3%</td>
<td>II</td>
<td></td>
<td></td>
</tr>
<tr>
<td>W1282X</td>
<td>1.2%</td>
<td>I</td>
<td></td>
<td></td>
</tr>
<tr>
<td>R553X</td>
<td>0.7%</td>
<td>I</td>
<td></td>
<td></td>
</tr>
<tr>
<td>621+1G&gt;T</td>
<td>0.7%</td>
<td>I</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1717-1G&gt;A</td>
<td>0.6%</td>
<td>I</td>
<td></td>
<td></td>
</tr>
<tr>
<td>R117H</td>
<td>0.3%</td>
<td>IV</td>
<td></td>
<td></td>
</tr>
<tr>
<td>R1162X</td>
<td>0.3%</td>
<td>Not clear ⁴</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

¹: From [1].
Genetic and Medical Web Sites

• National Library of Medicine and the National Center for Biotechnology Information
  – Genes and Diseases
  – Genetics Home Reference
  – Medline Plus
  – GeneReviews
  – Genetic Testing Registry
  – Clinical Trials
Where would you go for information on inherited diseases?

- Google or Google Scholar?
- National Center for Biotechnology Information
- Genes and Disease
- Genetics Home Reference
- Medline Plus
- Gene Reviews
- Online Mendelian Inheritance in Man (OMIM)
- MedGen – human medical genetics
- PubMed Keywords or PubMed MeSh search?
- PubMed Central
- PubMed Health
- Clinical Trials Database
Human Genome First draft
February 2001

Public Effort

Private Effort (Celera)
April, 2003 Completion
Genomic Medicine

The Dawn of Genomic Medicine
How a pediatrician working with the Amish is changing what it means to diagnose and treat disease
By Lisa Ballin

Why Waste Your Time Voting? (See Freshmanomics, Page 30)
Genomic Medicine

Healthcare tailored to the individual based on genomic information
The Pathway to Genomic Medicine

Interpreting the Human Genome Sequence

Implicating Genetic Variants with Human Disease

Realization of Genomic Medicine
NIH genome sequencing program targets the genomic bases of common, rare disease

The National Institutes of Health will fund a set of genome sequencing and analysis centers whose research will focus on understanding the genomic bases of common and rare human diseases. On January 14, the National Human Genome Research Institute (NHGRI), part of NIH, launched the Centers for Common Disease Genomics (CCDG), which will use genome sequencing to explore the genomic contributions to common diseases. Read more

Genome Advance of the Month

Gene-editing technology harnessed to protect plants from viruses

Scientists are using an exciting gene editing tool called CRISPR/Cas9 to protect plants from harmful DNA viruses. The CRISPR/Cas9 system has previously been adapted for use in many organisms, and this latest iteration develops gene-editing for use in plants. The November Genome Advance of the Month describes how these scientists inserted the code for an ancient bacterial immune system into a plant's genome to successfully strengthen the plant's protection against viruses. Read more

The Genomics Landscape

Future of ENCODE: Looking Deeper into Genome Function
Genome: Unlocking Life’s Code

The Genome Unlocking Life’s Code Exhibition

On June 14, 2013, the Smithsonian Institution in Washington, D.C. opened the high-tech, high-intensity exhibition Genome: Unlocking Life’s Code to celebrate the 10th anniversary of researchers producing the first complete human genome sequence - the genetic blueprint of the human body - in April 2003. The exhibition is a collaboration between the Smithsonian’s National Museum of Natural History (NMNH) and the National Human Genome Research Institute (NHGRI) of the National Institutes of Health.

Ongoing Programs

- Exhibition Website: Genome: Unlocking Life’s Code [unlockinglifescode.org]
- Traveling Exhibit [unlockinglifescode.org]
- Past Public Education Programs and Events
Ongoing Programs

- Exhibition Website: Genome: Unlocking Life’s Code [unlockinglifescodelic.org]
- Traveling Exhibit [unlockinglifescodelic.org]
- Past Public Education Programs and Events

Information to Enhance Your Visit

The Genomics Landscape a Decade After the Human Genome Project
Information and events about the 10th anniversary of the the Human Genome Project completion.

Genome: Unlocking Life’s Code - Videos and Animations

- YouTube Genome: Unlocking Life’s Code (2 videos)
- YouTube History Channel @ Videos (4 Videos)
- YouTube Medical Mystery Videos (3 Videos)
- YouTube Parts of the Cell, Chromosomes and Genes (23 animations)

- 🎧 What’s a Gene?
  Listen to some well-known scientists respond to the question, "What’s a gene?"

- 🎧 The African Diaspora: Integrating Culture, Genomics and History
  Videos from the September 12, 2013 symposium at the Smithsonian’s National Museum of Natural History.
Complete Genomics
http://www.completegenomics.com/

Accurate Whole Human Genome Sequencing & Analysis

Complete Genomics is a leader in accurate whole human genomic sequencing. Using our proprietary sequencing instruments, chemistry, and software, we have sequenced more than 15,000 whole human genomes for our research customers over the past three years. Our mission is to provide the technology for sequencing one million human genomes, enabling researchers and clinicians to improve human health through the prevention, diagnosis, and treatment of genetic diseases and conditions.
Personalis

http://www.personalis.com/

Personalis Genome Services for Researchers and Clinicians.
Genomes
Decoded and Delivered

Got DNA?
Learn how we make your clinical R&D more efficient →

Software and services that simplify the analysis and visualization of genome-scale data in clinical research and development. →

http://www.stationxinc.com/
Opal: Unlocking individualized medicine

Advances in whole-genome sequencing technology are paving the way for genome analysis to become a routine part of healthcare delivery. Interpretation of genomes is the key factor limiting their utility for clinical applications.

Introducing Omicia Opal

Omicia Opal empowers researchers and clinicians to analyze genomes and prioritize disease-causing variants and genes.

Omicia Opal combines powerful, peer-reviewed analysis tools with proprietary disease gene sets into an interactive genome mining, filtering, prioritizing, and reporting environment.

Omicia Opal is cloud-based, scalable, and secure. Genome interpretation is now at your fingertips.
GENOMICS PROMISES TO ADVANCE HEALTH

Our health depends upon both our genes and our environmental exposure. The current revolution in genomics makes it possible not only to determine our entire DNA sequence but also to begin to understand how our specific genome sequence can inform our health. In addition, our Center has recently demonstrated that it is possible to measure tens of thousands of components in blood to obtain a clear picture of our molecular picture during healthy and disease states. A combination of such sequence and molecular omics profiling is expected to be powerful in preventing, detecting, understanding, and treating complex diseases such as cancer and inherited diseases that are otherwise difficult to diagnose. Learn more ...

SCGPM FACILITATES TRANSLATION OF GENOMICS INTO PATIENT CENTERED MEDICINE

The Stanford Center for Genomics and Personalized Medicine (SCGPM) seeks to advance genomic technology so that someday both genetic and molecular profiling will become powerful and routine tools for predicting disease risk and monitoring and treating a wide range of pathologies. Towards this mission, the SCGPM serves to centralize and develop collaborative intellectual and technological resources that promote genomic research and analysis, predict drug response, educate physicians, and examine the ethics of personalized medicine. This includes large basic science projects such as ENCODE that decipher the human genome as well as clinical research projects such as the sequencing of cancer genomes and individuals with inherited diseases. Through these efforts, the Center aims to bring genomics to the clinic.

A MESSAGE FROM THE DIRECTOR

“Genomics is transforming both biological research and medicine. Stanford has long been a leader in this area and continues to develop new approaches to revolutionize the way medicine is practiced, so that disease can be rapidly diagnosed and the right treatment is applied at the right time.”

Mike Snyder, PhD
Chair, Stanford Department of Genetics
Stanford W. Ascherman, MD, FACS, Professor of Genetics
Director, SCGPM

ANNOUNCEMENTS

2013 SGTP Symposium

4th Annual Symposium on Genomics and Personalized Medicine

View Announcement and Registration
Note: Registration deadline is March 29, 2013; open to Stanford community only

SCGPM MEMBER RESEARCH AND NEWS
Portrait of a Glitch

• Revere La Noue, MFA, Stanford, 2005
What is this film about?

What classes of glitches are mentioned?

What do these glitches cause?

Why did I show this film?
Portrait of a Glitch

• Revere La Noue, MFA, Stanford, 2005
• What is this film about?
• What classes of glitches are mentioned?
• What do these glitches cause?
• Why did I show this film?
2007 SCIENTIFIC BREAKTHROUGH OF THE YEAR
Science Magazine, December 21, 2007

“It’s all about me!”

Single Nucleotide Polymorphisms (SNPs)

| Individual 1   | A A C A C G C C A ....  | T T C G G G G T C .... |
| Individual 2   | A A C A C G C C A ....  | T T C G A G G T C .... |
| Individual 3   | A A C A T G C C A ....  | T T C G G G G T C .... |
| Individual 4   | A A C A C G C C A ....  | T T C G G G G T C .... |
The Great Wave of GWAS Studies
http://www.genome.gov/gwastudies/

Hokusai, K. *The Great Wave*
Published Genome-Wide Associations through 12/2013
Published GWA at $p \leq 5 \times 10^{-8}$ for 17 trait categories

NHGRI GWA Catalog
www.genome.gov/GWASTudies
www.ebi.ac.uk/fgpt/gwas/
Personal Genomics: 23andMe
https://www.23andme.com/

Learn From Your DNA

With a simple saliva sample we'll help you gain insight into your traits, from baldness to muscle performance. Discover risk factors for 94 diseases. Know your predicted response to drugs, from blood thinners to coffee. And uncover your ancestral origins.

Plus, get alerts as new discoveries are made about your DNA!

$199
Our New Low Price For All!
* Requires a Personal Genome Service subscription at $5/month.

Order Now

Your Health
- Discover disease risk factors
- Screen for carrier status
- Know your predicted response to drugs

Your Ancestry
- Trace your ancestral lineage
- Find and connect with family members
- Uncover your heritage

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Navigenics
http://www.navigenics.com/

Gene–ius.
A smart way to look at your health.

Navigenics is the leading provider of clinically guided genetic analysis. Our goal is to empower you with genetic insights to help motivate you to improve your health. We also put a premium on privacy, keeping you in control of your genetic information.

New: Your genes, your medications
Will a new medication be effective for you? Will a treatment cause serious side effects? Now, genetic insights from Navigenics can help you and your doctor select medications that may be right for your genetic makeup.

Next Steps
- I'm new to Navigenics
- Adding to family history
- Genetic testing: Myths and truths
- Genetic knowledge can help you

For Physicians
- Free educational webinars
- More personalized care
- Genetic counselors for patients and you
- Foundation that rests on strong science

Success Stories

"We hear a lot of different — and sometimes conflicting — opinions about how to take care of our health. I’m very excited about receiving only the most relevant information to me, based on my DNA."

More Success Stories

Find a physician
Find a physician in your area who offers the Navigenics genetic testing services, so you can focus your health plan on prevention.

Find a physician now
Genetic Penetrance

Genetic diseases, at the left of the spectrum, are categorized as **single gene** or **chromosomal** disorders, depending on the specific genetic cause.

Diseases in the middle of the spectrum — including most common diseases — are **multifactorial**, and result from the interaction or additive effect of genetic and non-genetic factors.