






## Comprehensive Mitochondrial Nuclear Gene Panel

	<b>Test Code</b>	D4606
	<b>Test Summary</b>	This panel analyzes 254 genes that have been associated with mitochondrial disorders in nuclear genes.
	<b>Turn-Around-Time (TAT)*</b>	3 - 5 weeks
	<b>Acceptable Sample Types</b>	Whole Blood (EDTA) (Preferred sample type) DNA, Isolated Dried Blood Spots Saliva
	<b>Acceptable Billing Types</b>	Self (patient) Payment Institutional Billing Commercial Insurance

### Indications for Testing

This test may be appropriate for individuals with a clinical suspicion of a mitochondrial disorder and/or family history of a mitochondrial disorder.

### Test Description

This panel analyzes 254 genes that have been associated with mitochondrial disorders in nuclear genes. Both sequencing and deletion/duplication (CNV) analysis will be performed on the coding regions of all genes included (unless otherwise marked). All analysis is performed utilizing Next Generation Sequencing (NGS) technology. CNV analysis detects deletions and duplications of three exons or greater in size. All variants are classified according to ACMG guidelines.

### Condition Description

Mitochondrial disease is a varied group of disorders characterized by impaired energy production. Hallmarks of mitochondrial disease include neurological, cardiovascular, ophthalmologic, and gastroenterological features. It is estimated that 1/5,000 individuals have a genetic mitochondrial disease.

### Genes

AARS, AARS2, ABCB11, ABCB4, ABCB7, ABCD4, ACAD9, ACADM, ACADVL, ACO2, ACSF3, ADCK3, ADCK4, AFG3L2, AGK, AGL, AIFM1, ALAS2, ALDOA, ALDOB, ALG1, ALG11, ALG13, ALG2, ALG3, ALG6, ALG9, AMACR, APOPT1, APTX, ARG1, ASL, ASS1, ATP5A1, ATP5E, ATP7B, ATP8B1, ATPAF2, AUH, B4GALT1, BCKDHA, BCKDHB, BCS1L, BOLA3, C10ORF2, C12ORF65, C19orf12, CA5A, CARS2, CHKB, CISD2, CLPB, COA5, COA6, COASY, COG4, COG5, COG6, COG7, COG8, COQ2, COQ4, COQ6, COQ9, COX10, COX14, COX15, COX20, COX4I2, COX6A1, COX6B1, COX7B, CPS1, CPT1A, CPT2, CYC1, DARS, DARS2, DBT, DDHD1, DDHD2, DDOST, DGUOK, DLAT, DLD, DMGDH, DNA2, DNAJC19, DNM1L, DNM2, DOLK, DPAGT1, DPM1, DPM3, EARS2, ECHS1, ELAC2, ENO3, ETFA, ETFB, ETFDH, ETHE1, FAH, FARS2, FASTKD2, FBP1, FBXL4, FDX1L, FH, FLAD1, FOXRED1, G6PC, GAA, GAMT, GARS, GATM, GBE1, GCDH, GFER, GFM1, GFM2, GLRX5, GMPPA, GSS, GTPBP3, GYG1, GYG2, GYS1, GYS2, HADHA, HADHB, HARS2, HCFC1, HIBCH, HLCS, HMGCL, HMGCS2, HSD17B10, HSPD1, IARS2, IBA57, ISCA2, ISCU, IVD, LAMP2, LARS, LARS2, LDHA, LIAS, LIPT1, LMBRD1, LRPPRC, LYRM4, LYRM7, MARS, MARS2, MCCC1, MCCC2, MCEE, MFF, MFN2, MGAT2, MGME1, MICU1, MLYCD, MMAA, MMAB, MMACHC, MMADHC, MOGS, MPC1, MPDU1, MPI, MPV17, MRPL12, MRPL3, MRPL44, MRPS16, MRPS22, MRPS7, MTFMT, MTO1, MTPAP, MTR, MTRR, MUT, NADK2, NAGS, NARS2, NDUFA1, NDUFA10, NDUFA11, NDUFA12, NDUFA2, NDUFA4, NDUFA9, NDUFAF1, NDUFAF2, NDUFAF3, NDUFAF4, NDUFAF5, NDUFAF6, NDUFAF7, NDUFB3, NDUFB9, NDUFS1, NDUFS2, NDUFS3, NDUFS4, NDUFS6, NDUFS7, NDUFS8, NDUFV1, NDUFV2, NFS1, NFU1, NGLY1, NR2F1, NUBPL, OPA1, OPA3, OTC, PARS2, PC, PCCA, PCCB, PDHA1, PDHB, PDHX, PDP1, PDSS1, PDSS2, PET100, PFKM, PGAM2, PGM1, PHKA1, PHKA2, PHKB, PHKG2, PMM2, PNPT1, POLG, POLG2, PRKAG2, PRPS1, PTRH2, PUS1, PYGM, QARS1, RANBP2, RARS, RARS2, REEP1

## Test Methods and Limitations

Sequencing is performed on genomic DNA using an Agilent targeted sequence capture method to enrich for the genes on this panel. Direct sequencing of the amplified captured regions was performed using 2X100bp reads on Illumina next-generation sequencing (NGS) systems. A base is considered to have sufficient coverage at 20X and an exon is considered fully covered if all coding bases plus three nucleotides of flanking sequence on either side are covered at 20X or more. Low coverage regions, if any, are limited to ~1% or less of the nucleotides in the test unless a pathogenic variant explaining the phenotype is discovered. A list of these regions is available upon request. Alignment to the human reference genome (hg19) is performed and annotated variants are identified in the targeted region. Variants are called at a minimum coverage of 8X and an alternate allele frequency of 20% or higher. Single nucleotide variants (SNVs) meeting internal quality assessment guidelines are confirmed by Sanger sequence analysis for records after results are reported. Indels and SNVs are confirmed by Sanger sequence analysis before reporting at the director's discretion. This assay cannot detect variants in regions of the exome that are not covered, such as deep intronic, promoter, and enhancer regions, areas containing large numbers of tandem repeats, and variants in mitochondrial DNA. Copy number variation (CNV) analysis is designed to detect deletions and duplications of three exons or more; in some instances, due to the size of the exons or other factors, not all CNVs may be analyzed. This assay is not designed to detect mosaicism; possible cases of mosaicism may be investigated at the discretion of the laboratory director. Primary data analysis is performed using Illumina DRAGEN Bio-IT Platform v.3.4.12. Secondary and tertiary data analysis is performed using PerkinElmer's internal ODIN v.1.01 software for SNVs and Biodiscovery's NxClinical v.6.1 or Illumina DRAGEN Bio-IT Platform v.3.4.12 for CNV and absence of heterozygosity (AOH). Genes and/or exons located in pseudogene regions are not covered in this assay.

## Detailed Sample Requirements

### Whole Blood (EDTA) (Preferred sample type)

*Collection Container(s):*

EDTA (purple top)

*Collection:*

Infants (< 2-years): 2 to 3 mL; Children (>2-years): 3 to 5 mL; Older children and adults: Minimum 5mL. The blood tube should be inverted several times immediately after blood collection to prevent coagulation.

*Sample Condition:* Store at ambient temperature. Do not refrigerate or freeze.

*Shipping:* Ship overnight at ambient temperature ensuring receipt within 5-days of collection.

**SPECIAL INSTRUCTIONS:** Clotted or hemolyzed samples are not accepted.

### DNA, Isolated

*Collection:*

Required DNA Quantity by Test Type\*:

- **Next Generation Sequencing (NGS):** Send >1000 ng total gDNA @ >15 ng/?L. Please ship samples in 10mM Tris. Do not use EDTA.
- **Sanger Sequencing:** Send >500 ng total gDNA @ >15 ng/?L (varies by the size of the gene and the variants requested).
- **Non-Sanger Sequencing Tests:** Send >500 ng total gDNA @ >15 ng/?L.

*Sample Condition:* \* Required DNA Quality: High molecular weight DNA (>12kb). A260/A280 reading should be ? 1.8. A260/230 a ratio range of 1.8 to 2.2. Contact the laboratory for specific amounts if total ng cannot be met.

*Shipping:* Ship overnight at ambient temperature.

**SPECIAL INSTRUCTIONS:**



- **Research Laboratories:** DNA extracted in research laboratories is not acceptable. Only under exceptional circumstances (e.g., proband not available) will DNA extracted in a research laboratory be accepted for clinical testing. Additional testing (e.g., of other family members) may be required to confirm results.
- **Laboratories outside the United States:** Non-US laboratories are not subject to CLIA regulations and will be reviewed on a case-by-case basis. Please call to speak with a laboratory genetic counselor prior to submitting a DNA sample from any non-CLIA certified laboratory.
- **Special Notes:** If extracted DNA is submitted, information regarding the method used for extraction should be sent along with the sample.

## Dried Blood Spots

## Saliva

*Collection Container(s):*

Oragene™ Saliva Collection Kit or ORAcollect-Dx kit

*Collection:*

Collect saliva on an Oragene™ Saliva Collection Kit ORAcollect-Dx kit according to the manufacturer's instructions.

*Sample Condition:* Store at ambient temperature. Do not refrigerate or freeze.

*Shipping:* Ship overnight at ambient temperature.

**SPECIAL INSTRUCTIONS:** Please contact PerkinElmer to request the saliva collection kit for patients that cannot provide a blood sample as whole blood is the preferred sample.