



## Donor 6766

### Genetic Testing Summary

Fairfax Cryobank recommends reviewing this genetic testing summary with your healthcare provider to determine suitability.

Last Updated: 10/04/22

Donor Reported Ancestry: German, English, Irish

Jewish Ancestry: No

Genetic Test*	Result	Comments/Donor's Residual Risk**
Chromosome analysis (karyotype)	Normal male karyotype	No evidence of clinically significant chromosome abnormalities
Hemoglobin evaluation	Normal hemoglobin fractionation and MCV/MCH results	Reduced risk to be a carrier for sickle cell anemia, beta thalassemia, alpha thalassemia trait (aa/-- and a-/a-) and other hemoglobinopathies
Expanded Genetic Disease Carrier Screening Panel attached- 502 diseases by gene sequencing.  Personalized residual risk by gene is on attached report.	Carrier: Joubert Syndrome 4 / Senior-Loken Syndrome 1 /Juvenile Nephronophthisis 1 (NPHP1)  Negative for other genes sequenced	Partner testing recommended before using this donor.

\*No single test can screen for all genetic disorders. A negative screening result significantly reduces, but cannot eliminate, the risk for these conditions in a pregnancy.

\*\*Donor residual risk is the chance the donor is still a carrier after testing negative.

**Patient Information**

Name: Donor 6766  
 Date of Birth: [REDACTED]  
 Sema4 ID: [REDACTED]  
 Client ID: [REDACTED]  
 Indication: Carrier Screening

**Specimen Information**

Specimen Type: Blood  
 Date Collected: 02/25/2022  
 Date Received: 02/26/2022  
 Final Report: 03/15/2022

**Referring Provider**

[REDACTED]  
 Fairfax Cryobank, Inc.  
 [REDACTED]  
 [REDACTED]

## Expanded Carrier Screen (502 genes) with Personalized Residual Risk

### SUMMARY OF RESULTS AND RECOMMENDATIONS

⊕ Positive	⊖ Negative
<p><b>Carrier of Joubert Syndrome 4 / Senior-Loken Syndrome 1 / Juvenile Nephronophthisis 1 (AR)</b></p> <p>Associated gene(s): <i>NPHP1</i></p> <p>Variant(s) Detected: Deletion of exon 1-20, Pathogenic, Heterozygous (one copy)</p>	<p><b>Negative for all other genes tested</b></p> <p>To view a full list of genes and diseases tested please see Table 1 in this report</p>

*AR=Autosomal recessive; XL=X-linked*

**Recommendations**

- Testing the partner for the above positive disorder(s) and genetic counseling are recommended.
- Ultra-high resolution array (UHRMEA) may be considered to rule out the possibility of a larger deletion that includes additional disease genes.
- Please note that for female carriers of X-linked diseases, follow-up testing of a male partner is not indicated.
- CGG repeat analysis of *FMR1* for fragile X syndrome is not performed on males as repeat expansion of premutation alleles is not expected in the male germline.
- Individuals of Asian, African, Hispanic and Mediterranean ancestry should also be screened for hemoglobinopathies by CBC and hemoglobin electrophoresis.
- Consideration of residual risk by ethnicity after a negative carrier screen is recommended for the other diseases on the panel, especially in the case of a positive family history for a specific disorder.

## Interpretation of positive results

**Joubert Syndrome 4 / Senior-Loken Syndrome 1 / Juvenile Nephronophthisis 1 (AR)**

**Results and Interpretation**

A heterozygous (one copy) pathogenic deletion of exon 1-20 was detected in the *NPHP1* gene (NM\_000272.3). When this variant is present in trans with a pathogenic variant, it is considered to be causative for Joubert syndrome 4 / Senior-Loken syndrome 1 / juvenile nephronophthisis 1. Since this deletion spans the entire *NPHP1* gene, an ultra-high resolution array (UHRMEA) may be considered to determine the extent of the deletion. Therefore, this individual is expected to be at least a carrier for Joubert syndrome 4 / Senior-Loken syndrome 1 / juvenile nephronophthisis 1. Heterozygous carriers are not expected to exhibit symptoms of this disease.

**What is Joubert Syndrome 4 / Senior-Loken Syndrome 1 / Juvenile Nephronophthisis 1?**

*NPHP1*-related ciliopathies include three different overlapping disorders, known as Joubert syndrome 4, juvenile nephronophthisis 1, and Senior-Loken syndrome 1. All diseases are inherited in an autosomal recessive manner and are caused by pathogenic variants in the gene *NPHP1*.

- Joubert syndrome 4 is characterized by a distinct "molar tooth" sign on brain imaging. The clinical symptoms may include mild intellectual disability, abnormal eye movements, hypotonia, head tilt in infancy, and nephronophthisis with progressive kidney disease.
- Juvenile nephronophthisis 1 is characterized by nephronophthisis which may progress to end stage renal failure. Other symptoms may include liver fibrosis, situs inversus, or cardiac malformations. Without treatment to prevent progression to end-stage renal failure, life expectancy would be significantly reduced.
- Senior-Loken syndrome 1 is characterized by nephronophthisis and features of Leber congenital amaurosis. Affected individuals may develop early and severe vision loss. The clinical prognosis depends on the severity of renal complications as end-stage renal failure is the major cause of death.

No clear genotype-phenotype correlation has been established.

## Test description

This patient was tested for a panel of diseases using a combination of sequencing, targeted genotyping and copy number analysis. Please note that negative results reduce but do not eliminate the possibility that this individual is a carrier for one or more of the disorders tested. Please see Table 1 for a list of genes and diseases tested with the patient's personalized residual risk. If personalized residual risk is not provided, please see the complete residual risk table at [go.sema4.com/residualrisk](https://go.sema4.com/residualrisk). Only variants determined to be pathogenic or likely pathogenic are reported in this carrier screening test.



**Alice Tanner, Ph.D., M.S., CGC, FACMG, Laboratory Director**

Laboratory Medical Consultant: George A. Diaz, M.D., Ph.D

## Genes and diseases tested

The personalized residual risks listed below are specific to this individual. The complete residual risk table is available at [go.sema4.com/residualrisk](https://go.sema4.com/residualrisk)

Table 1: List of genes and diseases tested with detailed results

Disease	Gene	Inheritance Pattern	Status	Detailed Summary
<b>Positive</b>				
<b>Joubert Syndrome 4 / Senior-Loken Syndrome 1 / Juvenile Nephronophthisis 1</b>	<i>NPHP1</i>	AR	Carrier	Deletion of exon 1-20. Pathogenic, Heterozygous (one copy)
<b>Negative</b>				
<b>2-Methylbutyrylglycinuria</b>	<i>ACADSB</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 2,800
<b>3-Beta-Hydroxysteroid Dehydrogenase Type II Deficiency</b>	<i>HSD3B2</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 3,300
<b>3-Methylcrotonyl-CoA Carboxylase Deficiency (MCCC1-Related)</b>	<i>MCCC1</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 3,400
<b>3-Methylcrotonyl-CoA Carboxylase Deficiency (MCCC2-Related)</b>	<i>MCCC2</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 1,200
<b>3-Methylglutaconic Aciduria, Type III</b>	<i>OPA3</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 50,000
<b>3-Phosphoglycerate Dehydrogenase Deficiency</b>	<i>PHGDH</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 63,000
<b>6-Pyruvoyl-Tetrahydropterin Synthase Deficiency</b>	<i>PTS</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 1,800
<b>CD59-Mediated Hemolytic Anemia</b>	<i>CD59</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 415,000
<b>Abetalipoproteinemia</b>	<i>MTTP</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 3,200
<b>Achalasia-Addisonianism-Alacrimia Syndrome</b>	<i>AAAS</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 4,500
<b>Achromatopsia (CNGA3-Related)</b>	<i>CNGA3</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 830
<b>Achromatopsia (CNGB3-related)</b>	<i>CNGB3</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 8,600
<b>Acrodermatitis Enteropathica</b>	<i>SLC39A4</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 12,000
<b>Acute Infantile Liver Failure</b>	<i>TRMU</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 9,400
<b>Acyl-CoA Oxidase I Deficiency</b>	<i>ACOX1</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 39,000
<b>Adams-Oliver Syndrome 4</b>	<i>EOGT</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 44,000
<b>Adenosine Deaminase Deficiency</b>	<i>ADA</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 5,100
<b>Adrenocorticotrophic Hormone Deficiency</b>	<i>TBX19</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 35,000
<b>Adrenoleukodystrophy, X-Linked</b>	<i>ABCD1</i>	XL	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 19,000
<b>Agammaglobulinemia</b>	<i>BTK</i>	XL	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 250,000
<b>Agnesis of the Corpus Callosum</b>	<i>FRMD4A</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 1,393,000
<b>Aicardi-Goutieres Syndrome (RNASEH2C-Related)</b>	<i>RNASEH2C</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 11,000
<b>Aicardi-Goutieres Syndrome (SAMHD1-Related)</b>	<i>SAMHD1</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 10,000
<b>Aicardi-Goutieres Syndrome (TREX1-Related)</b>	<i>TREX1</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 3,200
<b>Albinism, Oculocutaneous, Type III</b>	<i>TYRP1</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 3,500
<b>Alkaptonuria</b>	<i>HGD</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 1,100
<b>Alpha-Mannosidosis</b>	<i>MAN2B1</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 6,200
<b>Alpha-Thalassemia</b>	<i>HBA1/HBA2</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 10,000 <i>HBA1</i> Copy Number: 2 <i>HBA2</i> Copy Number: 2 No pathogenic copy number variants detected <i>HBA1/HBA2</i> Sequencing: Negative
<b>Alpha-Thalassemia Intellectual Disability Syndrome</b>	<i>ATRX</i>	XL	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 48,000
<b>Alport Syndrome (COL4A3-Related)</b>	<i>COL4A3</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 1,800

Alport Syndrome ( <i>COL4A4</i> -Related)	<i>COL4A4</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 1,800
Alport Syndrome ( <i>COL4A5</i> -Related)	<i>COL4A5</i>	XL	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 150,000
Alstrom Syndrome	<i>ALMS1</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 3,800
Andermann Syndrome	<i>SLC12A6</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 151,000
Antley-Bixler Syndrome ( <i>POR</i> -Related)	<i>POR</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 4,000
Argininemia	<i>ARG1</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 6,500
Argininosuccinic Aciduria	<i>ASL</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 1,200
Aromatase Deficiency	<i>CYP19A1</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 5,400
Arthrogryposis, Intellectual Disability, and Seizures	<i>SLC35A3</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 454,000
Asparagine Synthetase Deficiency	<i>ASNS</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 202,000
Aspartylglycosaminuria	<i>AGA</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 13,000
Ataxia With Isolated Vitamin E Deficiency	<i>TTPA</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 61,000
Ataxia-Telangiectasia	<i>ATM</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 1,300
Ataxia-Telangiectasia-Like Disorder 1	<i>MRE11</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 5,500
Autosomal Recessive Spastic Ataxia of Charlevoix-Saguenay	<i>SACS</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 2,600
BH4-Deficient Hyperphenylalaninemia C	<i>QDPR</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 3,100
BH4-Deficient Hyperphenylalaninemia D	<i>PCBD1</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 8,000
Bardet-Biedl Syndrome ( <i>ARL6</i> -Related)	<i>ARL6</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 29,000
Bardet-Biedl Syndrome ( <i>BBS10</i> -Related)	<i>BBS10</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 2,700
Bardet-Biedl Syndrome ( <i>BBS12</i> -Related)	<i>BBS12</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 9,900
Bardet-Biedl Syndrome ( <i>BBS1</i> -Related)	<i>BBS1</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 6,400
Bardet-Biedl Syndrome ( <i>BBS2</i> -Related)	<i>BBS2</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 1,200
Bardet-Biedl Syndrome ( <i>BBS4</i> -Related)	<i>BBS4</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 22,000
Bare Lymphocyte Syndrome, Type II	<i>CIITA</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 35,000
Barth Syndrome	<i>TAZ</i>	XL	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 183,000
Bartter Syndrome, Type 3	<i>CLCNKB</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 740
Bartter Syndrome, Type 4A	<i>BSND</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 91,000
Bernard-Soutier Syndrome, Type A1	<i>GP1BA</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 42,000
Bernard-Soutier Syndrome, Type C	<i>GP9</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 3,300
Beta-Globin-Related Hemoglobinopathies	<i>HBB</i>	AR	Reduced Risk	<b>Personalized Residual Risk (Beta-Globin-Related Hemoglobinopathies):</b> 1 in 2,000 <b>Personalized Residual Risk (Beta-Globin-Related Hemoglobinopathies: HbS Variant):</b> 1 in 790,000 <b>Personalized Residual Risk (Beta-Globin-Related Hemoglobinopathies: HbC Variant):</b> 1 in 2,107,000
Beta-Ketothiolase Deficiency	<i>ACAT1</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 5,400
Beta-Mannosidosis	<i>MANBA</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 9,100
Bilateral Frontoparietal Polymicrogyria	<i>GPR56</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 203,000
Biotinidase Deficiency	<i>BTBD</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 500
Bloom Syndrome	<i>BLM</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 7,400
Canavan Disease	<i>ASPA</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 4,000
Carbamoylphosphate Synthetase I Deficiency	<i>CPS1</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 1,100
Carnitine Acylcarnitine Translocase Deficiency	<i>SLC25A20</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 4,100
Carnitine Palmitoyltransferase IA Deficiency	<i>CPT1A</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 24,000
Carnitine Palmitoyltransferase II Deficiency	<i>CPT2</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 670
Carpenter Syndrome	<i>RAB23</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 21,000
Cartilage-Hair Hypoplasia	<i>RMRP</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 960
Catecholaminergic Polymorphic Ventricular Tachycardia	<i>CASQ2</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 5,900

Central Hypothyroidism and Testicular Enlargement	<i>IGSF1</i>	XL	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 781,000
Cerebral Creatine Deficiency Syndrome 1	<i>SLC6A8</i>	XL	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 208,000
Cerebral Creatine Deficiency Syndrome 2	<i>GAMT</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 2,100
Cerebral Creatine Deficiency Syndrome 3	<i>GATM</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 7,900
Cerebral Dysgenesis, Neuropathy, Ichthyosis, and Palmoplantar Keratoderma Syndrome	<i>SNAP29</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 1,730,000
Cerebrotendinous Xanthomatosis	<i>CYP27A1</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 3,900
Charcot-Marie-Tooth Disease, Type 4D	<i>NDRG1</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 730,000
Charcot-Marie-Tooth Disease, Type 5 / Arts Syndrome	<i>PRPS1</i>	XL	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 114,000
Charcot-Marie-Tooth Disease, X-Linked	<i>GJB1</i>	XL	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 11,000
Chediak-Higashi Syndrome	<i>LYST</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 7,100
Chondrodysplasia Punctata	<i>ARSE</i>	XL	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 862,000
Choreoacanthocytosis	<i>VPS13A</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 13,000
Choroideremia	<i>CHM</i>	XL	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 125,000
Chronic Granulomatous Disease (CYBA-Related)	<i>CYBA</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 5,000
Chronic Granulomatous Disease (CYBB-Related)	<i>CYBB</i>	XL	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 294,000
Citrin Deficiency	<i>SLC25A13</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 12,000
Citrullinemia, Type 1	<i>ASS1</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 2,500
Cockayne Syndrome, Type A	<i>ERCC8</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 8,900
Cockayne Syndrome, Type B and other ERCC6-Related Disorders	<i>ERCC6</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 8,100
Cohen Syndrome	<i>VPS13B</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 6,400
Combined Factor V and VIII Deficiency	<i>LMAN1</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 102,000
Combined Malonic and Methylmalonic Aciduria	<i>ACSF3</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 2,400
Combined Oxidative Phosphorylation Deficiency 1	<i>GFM1</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 13,000
Combined Oxidative Phosphorylation Deficiency 3	<i>TSMF</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 27,000
Combined Pituitary Hormone Deficiency 1	<i>POU1F1</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 3,900
Combined Pituitary Hormone Deficiency 2	<i>PROP1</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 2,800
Combined Pituitary Hormone Deficiency 3	<i>LHX3</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 140,000
Combined SAP Deficiency	<i>PSAP</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 44,000
Cone-Rod Dystrophy 6 / Leber Congenital Amaurosis 1	<i>GUCY2D</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 1,200
Congenital Adrenal Hyperplasia due to 11-Beta-Hydroxylase Deficiency	<i>CYP11B1</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 520
Congenital Adrenal Hyperplasia due to 17-Alpha-Hydroxylase Deficiency	<i>CYP17A1</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 1,800
Congenital Adrenal Hyperplasia due to 21-Hydroxylase Deficiency	<i>CYP21A2</i>	AR	Reduced Risk	<i>CYP21A2</i> copy number: 2 <i>CYP21A2</i> sequencing: Negative <b>Personalized Residual Risk (Congenital Adrenal Hyperplasia due to 21-Hydroxylase Deficiency (Non-Classic)):</b> 1 in 200 <b>Personalized Residual Risk (Congenital Adrenal Hyperplasia due to 21-Hydroxylase Deficiency (Classic)):</b> 1 in 1,300
Congenital Adrenal Hypoplasia (NR0B1-Related)	<i>NR0B1</i>	XL	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 353,000
Congenital Adrenal Insufficiency (CYP11A1-Related)	<i>CYP11A1</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 6,100
Congenital Amegakaryocytic Thrombocytopenia	<i>MPL</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 3,100
Congenital Bile Acid Synthesis Defect (AKR1D1-Related)	<i>AKR1D1</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 6,900
Congenital Bile Acid Synthesis Defect (HSD3B7-Related)	<i>HSD3B7</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 8,900
Congenital Disorder of Deglycosylation	<i>NGLY1</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 14,000
Congenital Disorder of Glycosylation, Type Ia	<i>PMM2</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 540

<b>Congenital Disorder of Glycosylation, Type Ib</b>	<i>MPI</i>	AR	Reduced Risk	<b>Personalized Residual Risk: 1 in 5,600</b>
<b>Congenital Disorder of Glycosylation, Type Ic</b>	<i>ALG6</i>	AR	Reduced Risk	<b>Personalized Residual Risk: 1 in 4,100</b>
<b>Congenital Disorder of Glycosylation, Type Im</b>	<i>DOLK</i>	AR	Reduced Risk	<b>Personalized Residual Risk: 1 in 134,000</b>
<b>Congenital Dyserythropoietic Anemia Type 2</b>	<i>SEC23B</i>	AR	Reduced Risk	<b>Personalized Residual Risk: 1 in 1,000</b>
<b>Congenital Dyserythropoietic Anemia, Type Ia</b>	<i>CDAN1</i>	AR	Reduced Risk	<b>Personalized Residual Risk: 1 in 470</b>
<b>Congenital Ichthyosis 4A and 4B</b>	<i>ABCA12</i>	AR	Reduced Risk	<b>Personalized Residual Risk: 1 in 5,100</b>
<b>Congenital Insensitivity to Pain with Anhidrosis</b>	<i>NTRK1</i>	AR	Reduced Risk	<b>Personalized Residual Risk: 1 in 5,700</b>
<b>Congenital Muscular Dystrophy (LAMA2-Related)</b>	<i>LAMA2</i>	AR	Reduced Risk	<b>Personalized Residual Risk: 1 in 640</b>
<b>Congenital Myasthenic Syndrome (CHAT-Related)</b>	<i>CHAT</i>	AR	Reduced Risk	<b>Personalized Residual Risk: 1 in 3,100</b>
<b>Congenital Myasthenic Syndrome (CHRNE-Related)</b>	<i>CHRNE</i>	AR	Reduced Risk	<b>Personalized Residual Risk: 1 in 4,100</b>
<b>Congenital Myasthenic Syndrome (DOK7-Related)</b>	<i>DOK7</i>	AR	Reduced Risk	<b>Personalized Residual Risk: 1 in 1,200</b>
<b>Congenital Myasthenic Syndrome (RAPSN-Related)</b>	<i>RAPSN</i>	AR	Reduced Risk	<b>Personalized Residual Risk: 1 in 2,900</b>
<b>Congenital Neutropenia (HAX1-Related)</b>	<i>HAX1</i>	AR	Reduced Risk	<b>Personalized Residual Risk: 1 in 82,000</b>
<b>Congenital Neutropenia (VPS45-Related)</b>	<i>VPS45</i>	AR	Reduced Risk	<b>Personalized Residual Risk: 1 in 163,000</b>
<b>Congenital Nongoitrous Hypothyroidism 1</b>	<i>TSHR</i>	AR	Reduced Risk	<b>Personalized Residual Risk: 1 in 1,000</b>
<b>Congenital Nongoitrous Hypothyroidism 4</b>	<i>TSHB</i>	AR	Reduced Risk	<b>Personalized Residual Risk: 1 in 118,000</b>
<b>Congenital Secretory Chloride Diarrhea 1</b>	<i>SLC26A3</i>	AR	Reduced Risk	<b>Personalized Residual Risk: 1 in 2,400</b>
<b>Corneal Dystrophy and Perceptive Deafness</b>	<i>SLC4A11</i>	AR	Reduced Risk	<b>Personalized Residual Risk: 1 in 4,600</b>
<b>Corticosterone Methyloxidase Deficiency</b>	<i>CYP11B2</i>	AR	Reduced Risk	<b>Personalized Residual Risk: 1 in 1,500</b>
<b>Cystic Fibrosis</b>	<i>CFTR</i>	AR	Reduced Risk	<b>Personalized Residual Risk: 1 in 440</b>
<b>Cystinosis</b>	<i>CTNS</i>	AR	Reduced Risk	<b>Personalized Residual Risk: 1 in 7,700</b>
<b>Cystinuria (SLC3A1-Related)</b>	<i>SLC3A1</i>	AR	Reduced Risk	<b>Personalized Residual Risk: 1 in 590</b>
<b>Cytochrome C Oxidase Deficiency / Leigh Syndrome (COX15-Related)</b>	<i>COX15</i>	AR	Reduced Risk	<b>Personalized Residual Risk: 1 in 3,300</b>
<b>D-Bifunctional Protein Deficiency</b>	<i>HSD17B4</i>	AR	Reduced Risk	<b>Personalized Residual Risk: 1 in 5,000</b>
<b>Deafness, Autosomal Recessive 3</b>	<i>MYO15A</i>	AR	Reduced Risk	<b>Personalized Residual Risk: 1 in 240</b>
<b>Deafness, Autosomal Recessive 59</b>	<i>PJVK</i>	AR	Reduced Risk	<b>Personalized Residual Risk: 1 in 57,000</b>
<b>Deafness, Autosomal Recessive 7</b>	<i>TMC1</i>	AR	Reduced Risk	<b>Personalized Residual Risk: 1 in 1,200</b>
<b>Deafness, Autosomal Recessive 76</b>	<i>SYNE4</i>	AR	Reduced Risk	<b>Personalized Residual Risk: 1 in 43,000</b>
<b>Deafness, Autosomal Recessive 77</b>	<i>LOXHD1</i>	AR	Reduced Risk	<b>Personalized Residual Risk: 1 in 6,700</b>
<b>Deafness, Autosomal Recessive 8/10</b>	<i>TMPRSS3</i>	AR	Reduced Risk	<b>Personalized Residual Risk: 1 in 510</b>
<b>Deafness, Autosomal Recessive 9</b>	<i>OTOF</i>	AR	Reduced Risk	<b>Personalized Residual Risk: 1 in 1,400</b>
<b>Desbuquois Dysplasia 1</b>	<i>CANT1</i>	AR	Reduced Risk	<b>Personalized Residual Risk: 1 in 24,000</b>
<b>Desmoterolosis</b>	<i>DHCR24</i>	AR	Reduced Risk	<b>Personalized Residual Risk: 1 in 27,000</b>
<b>Diaphanospondylydysostosis</b>	<i>BMPER</i>	AR	Reduced Risk	<b>Personalized Residual Risk: 1 in 18,000</b>
<b>Distal Renal Tubular Acidosis and other SLC4A1-related Disorders</b>	<i>SLC4A1</i>	AR	Reduced Risk	<b>Personalized Residual Risk: 1 in 4,000</b>
<b>Duchenne Muscular Dystrophy / Becker Muscular Dystrophy</b>	<i>DMD</i>	XL	Reduced Risk	<b>Personalized Residual Risk: 1 in 10,000</b>
<b>Dyskeratosis Congenita (DKC1-related)</b>	<i>DKC1</i>	XL	Reduced Risk	<b>Personalized Residual Risk: 1 in 9,259,000</b>
<b>Dyskeratosis Congenita (RTEL1-Related)</b>	<i>RTEL1</i>	AR	Reduced Risk	<b>Personalized Residual Risk: 1 in 9,800</b>
<b>Dystrophic Epidermolysis Bullosa</b>	<i>COL7A1</i>	AR	Reduced Risk	<b>Personalized Residual Risk: 1 in 900</b>
<b>Ehlers-Danlos Syndrome, Type VI</b>	<i>PLOD1</i>	AR	Reduced Risk	<b>Personalized Residual Risk: 1 in 20,000</b>
<b>Ehlers-Danlos Syndrome, Type VIIC</b>	<i>ADAMTS2</i>	AR	Reduced Risk	<b>Personalized Residual Risk: 1 in 243,000</b>
<b>Ellis-Van Creveld Syndrome (EVC2-Related)</b>	<i>EVC2</i>	AR	Reduced Risk	<b>Personalized Residual Risk: 1 in 6,300</b>
<b>Ellis-van Creveld Syndrome (EVC-Related)</b>	<i>EVC</i>	AR	Reduced Risk	<b>Personalized Residual Risk: 1 in 4,200</b>
<b>Emery-Dreifuss Myopathy 1</b>	<i>EMD</i>	XL	Reduced Risk	<b>Personalized Residual Risk: 1 in 833,000</b>
<b>Enhanced S-Cone Syndrome</b>	<i>NR2E3</i>	AR	Reduced Risk	<b>Personalized Residual Risk: 1 in 1,600</b>
<b>Ethylmalonic Encephalopathy</b>	<i>ETHE1</i>	AR	Reduced Risk	<b>Personalized Residual Risk: 1 in 3,400</b>

Fabry Disease	GLA	XL	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 7,700
Factor IX Deficiency	F9	XL	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 5,100
Factor VII Deficiency	F7	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 450
Factor XI Deficiency	F11	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 1,500
Familial Autosomal Recessive Hypercholesterolemia	LDLRAP1	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 136,000
Familial Dysautonomia	IKBKAP	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 51,000
Familial Hypercholesterolemia	LDLR	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 280
Familial Hyperinsulinemic Hypoglycemia 4 / 3-Hydroxyacyl-CoA Dehydrogenase Deficiency	HADH	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 9,200
Familial Hyperinsulinism (ABCC8-Related)	ABCC8	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 450
Familial Hyperinsulinism (KCNJ11-Related)	KCNJ11	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 5,300
Familial Hyperphosphatemic Tumorlike Calcinosi	GALNT3	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 7,800
Familial Mediterranean Fever	MEFV	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 1,200
Fanconi Anemia, Group A	FANCA	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 1,100
Fanconi Anemia, Group C	FANCC	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 12,000
Fanconi Anemia, Group G	FANCG	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 28,000
Fanconi-Bickel Syndrome	SLC2A2	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 4,000
Fragile X Syndrome	FMR1	XL	Reduced Risk	FMR1 CGG repeat sizes: Not Performed FMR1 Sequencing: Negative Fragile X CGG triplet repeat expansion testing was not performed at this time, as the patient has either been previously tested or is a male. <b>Personalized Residual Risk:</b> 1 in 19,000
Fructose-1,6-Bisphosphatase Deficiency	FBP1	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 2,600
Fucosidosis	FUCA1	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 9,200
Fumarase Deficiency	FH	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 2,500
Fundus Albipunctatus	RDH5	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 2,000
GRACILE Syndrome and Other BCS1L-Related Disorders	BCS1L	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 3,900
Galactokinase Deficiency	GALK1	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 2,700
Galactose Epimerase Deficiency	GALE	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 5,600
Galactosemia	GALT	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 3,200
Galactosialidosis	CTSA	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 7,900
Gaucher Disease	GBA	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 1,300
Generalized Thyrotropin-Releasing Hormone Resistance	TRHR	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 104,000
Geroderma Osteodysplasticum	GORAB	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 70,000
Gitelman Syndrome	SLC12A3	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 290
Glanzmann Thrombasthenia (ITGA2B-Related)	ITGA2B	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 1,800
Glanzmann Thrombasthenia (ITGB3-Related)	ITGB3	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 1,600
Glutaric Acidemia, Type I	GCDH	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 2,700
Glutaric Acidemia, Type IIa	ETFA	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 4,700
Glutaric Acidemia, Type IIb	ETFB	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 5,900
Glutaric Acidemia, Type IIc	ETFDH	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 1,700
Glutathione Synthetase Deficiency	GSS	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 3,500
Glycine Encephalopathy (AMT-Related)	AMT	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 5,700
Glycine Encephalopathy (GLDC-Related)	GLDC	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 760
Glycogen Storage Disease, Type 0	GYS2	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 1,200
Glycogen Storage Disease, Type II	GAA	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 520
Glycogen Storage Disease, Type III	AGL	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 5,600
Glycogen Storage Disease, Type IV / Adult Polyglucosan Body Disease	GBE1	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 2,400
Glycogen Storage Disease, Type IXb	PHKB	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 2,600



Glycogen Storage Disease, Type Ia	<i>G6PC</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 5,300
Glycogen Storage Disease, Type Ib	<i>SLC37A4</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 7,300
Glycogen Storage Disease, Type V	<i>PYGM</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 1,200
Glycogen Storage Disease, Type VI	<i>PYGL</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 1,600
Glycogen Storage Disease, Type VII	<i>PFKM</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 4,300
Gray Platelet Syndrome	<i>NBEAL2</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 6,800
Growth Hormone Deficiency, Type IB	<i>GHRHR</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 3,900
HMG-CoA Lyase Deficiency	<i>HMGCL</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 2,700
Hemochromatosis, Type 2A	<i>HFE2</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 12,000
Hemochromatosis, Type 3	<i>TFR2</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 11,000
Hereditary Fructose Intolerance	<i>ALDOB</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 1,900
Hereditary Spastic Paraparesis 49	<i>TECPR2</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 116,000
Hermansky-Pudlak Syndrome, Type 1	<i>HPS1</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 3,500
Hermansky-Pudlak Syndrome, Type 3	<i>HPS3</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 49,000
Hermansky-Pudlak Syndrome, Type 4	<i>HPS4</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 35,000
Hermansky-Pudlak Syndrome, Type 6	<i>HPS6</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 87,000
Hmg-CoA Synthase 2 Deficiency	<i>HMGCS2</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 2,000
Holocarboxylase Synthetase Deficiency	<i>HLCS</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 5,500
Homocystinuria (CBS-Related)	<i>CBS</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 1,400
Homocystinuria due to <i>MTHFR</i> Deficiency	<i>MTHFR</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 1,300
Homocystinuria, cblE Type	<i>MTRR</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 9,600
Homocystinuria-Megaloblastic Anemia, Cobalamin G Type	<i>MTR</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 2,100
Hydrocephalus	<i>L1CAM</i>	XL	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 40,000
Hydrolethals Syndrome	<i>HYLS1</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 52,000
Hyper-Igm Syndrome	<i>CD40LG</i>	XL	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 1,167,000
Hyperornithinemia-Hyperammonemia-Homocitrullinuria Syndrome	<i>SLC25A15</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 5,700
Hyperuricemia, Pulmonary Hypertension, Renal Failure, and Alkalosis	<i>SARS2</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 23,000
Hypohidrotic Ectodermal Dysplasia 1	<i>EDA</i>	XL	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 22,000
Hypomagnesemia 1	<i>TRPM6</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 11,000
Hypomyelinating Leukodystrophy 3	<i>AIMP1</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 341,000
Hypomyelinating Leukodystrophy 12	<i>VPS11</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 72,000
Hypoparathyroidism-Retardation-Dysmorphic Syndrome	<i>TBCE</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 21,000
Hypophosphatasia	<i>ALPL</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 790
Hypophosphatemic Rickets with Hypercalciuria	<i>SLC34A3</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 1,200
Hypotrichosis 8 / Autosomal Recessive Woolly Hair 1	<i>LPAR6</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 27,000
Immunodeficiency 18	<i>CD3E</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 73,000
Immunodeficiency 19	<i>CD3D</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 46,000
Inclusion Body Myopathy 2	<i>GNE</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 2,000
Infantile Cerebral and Cerebellar Atrophy	<i>MED17</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 129,000
Infantile Neuroaxonal Dystrophy 1 and other <i>PLA2G6</i> -Related Disorders	<i>PLA2G6</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 690
Intellectual Disability, Autosomal Recessive 3	<i>CC2D1A</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 220,000
Intrahepatic Cholestasis	<i>ATP8B1</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 1,400
Isovaleric Acidemia	<i>IVD</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 2,000
Joubert Syndrome 2	<i>TMEM216</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 152,000
Joubert Syndrome 7 / Meckel Syndrome 5 / COACH Syndrome	<i>RPGRIP1L</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 32,000
Junctional Epidermolysis Bullosa ( <i>COL17A1</i> -Related)	<i>COL17A1</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 25,000

Junctional Epidermolysis Bullosa ( <i>ITGA6</i> -Related)	<i>ITGA6</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 125,000
Junctional Epidermolysis Bullosa ( <i>ITGB4</i> -Related)	<i>ITGB4</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 2,400
Junctional Epidermolysis Bullosa ( <i>LAMA3</i> -Related)	<i>LAMA3</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 21,000
Junctional Epidermolysis Bullosa ( <i>LAMB3</i> -Related)	<i>LAMB3</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 1,900
Junctional Epidermolysis Bullosa ( <i>LAMC2</i> -Related)	<i>LAMC2</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 77,000
Kohlschutter-Tonz Syndrome	<i>ROGDI</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 2,300
Krabbe Disease	<i>GALC</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 860
Lamellar Ichthyosis, Type 1	<i>TGM1</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 1,500
Laron Dwarfism	<i>GHR</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 6,700
Leber Congenital Amaurosis 10 and Other CEP290-Related Ciliopathies	<i>CEP290</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 1,100
Leber Congenital Amaurosis 13	<i>RDH12</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 5,500
Leber Congenital Amaurosis 15 / Retinitis Pigmentosa 14	<i>TULP1</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 2,800
Leber Congenital Amaurosis 2 / Retinitis Pigmentosa 20	<i>RPE65</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 2,500
Leber Congenital Amaurosis 4	<i>AIP1</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 2,100
Leber Congenital Amaurosis 5	<i>LCA5</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 14,000
Leber Congenital Amaurosis 8 / Retinitis Pigmentosa 12 / Pigmented Paravenous Chorioretinal Atrophy	<i>CRB1</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 990
Leigh Syndrome ( <i>NDUFS7</i> -Related)	<i>NDUFS7</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 26,000
Leigh Syndrome ( <i>SURF1</i> -Related)	<i>SURF1</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 4,400
Leigh Syndrome, French-Canadian Type	<i>LRPPRC</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 32,000
Lethal Congenital Contracture Syndrome 1 / Lethal Arthrogyposis with Anterior Horn Cell Disease	<i>GLE1</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 10,000
Lethal Congenital Contracture Syndrome 2	<i>ERBB3</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 96,000
Lethal Congenital Contracture Syndrome 3	<i>PIP5K1C</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 318,000
Leukoencephalopathy with Vanishing White Matter	<i>EIF2B5</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 2,300
Limb-Girdle Muscular Dystrophy, Type 2A	<i>CAPN3</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 960
Limb-Girdle Muscular Dystrophy, Type 2B	<i>DYSF</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 1,100
Limb-Girdle Muscular Dystrophy, Type 2C	<i>SGCG</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 4,900
Limb-Girdle Muscular Dystrophy, Type 2D	<i>SGCA</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 3,500
Limb-Girdle Muscular Dystrophy, Type 2E	<i>SGCB</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 31,000
Limb-Girdle Muscular Dystrophy, Type 2F	<i>SGCD</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 52,000
Limb-Girdle Muscular Dystrophy, Type 2H	<i>TRIM32</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 10,000
Limb-Girdle Muscular Dystrophy, Type 2I	<i>FKRP</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 1,400
Limb-Girdle Muscular Dystrophy, Type 2L	<i>ANO5</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 660
Lipoamide Dehydrogenase Deficiency	<i>DLD</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 14,000
Lipoid Adrenal Hyperplasia	<i>STAR</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 3,600
Lipoprotein Lipase Deficiency	<i>LPL</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 2,400
Long-Chain 3-Hydroxyacyl-CoA Dehydrogenase Deficiency	<i>HADHA</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 5,900
Lowe Syndrome	<i>OCRL</i>	XL	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 1,375,000
Lysinuric Protein Intolerance	<i>SLC7A7</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 3,000
MEDNIK Syndrome	<i>AP1S1</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 211,000
Malonyl-CoA Decarboxylase Deficiency	<i>MLYCD</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 2,800
Maple Syrup Urine Disease, Type 1a	<i>BCKDHA</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 5,100
Maple Syrup Urine Disease, Type 1b	<i>BCKDHB</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 1,100

Maple Syrup Urine Disease, Type 2	<i>DBT</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 3,600
Meckel Syndrome 1 / Bardet-Biedl Syndrome 13	<i>MKS1</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 1,700
Medium Chain Acyl-CoA Dehydrogenase Deficiency	<i>ACADM</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 1,800
Megalencephalic Leukoencephalopathy with Subcortical Cysts	<i>MLC1</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 4,300
Megaloblastic Anemia 1	<i>AMN</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 6,300
Menkes Disease	<i>ATP7A</i>	XL	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 172,000
Metachromatic Leukodystrophy	<i>ARSA</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 1,000
Methionine Adenosyltransferase I/III Deficiency	<i>MAT3A</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 1,900
Methylmalonic Acidemia (MMAA-Related)	<i>MMAA</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 15,000
Methylmalonic Acidemia (MMAB-Related)	<i>MMAB</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 12,000
Methylmalonic Acidemia (MUT-Related)	<i>MUT</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 1,300
Methylmalonic Aciduria and Homocystinuria, Cobalamin C Type	<i>MMACHC</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 6,800
Methylmalonic Aciduria and Homocystinuria, Cobalamin D Type	<i>MMADHC</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 219,000
Methylmalonic Aciduria and Homocystinuria, Cobalamin F Type	<i>LMBRD1</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 6,600
Methylmalonyl-CoA Epimerase Deficiency	<i>MCEE</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 98,000
Microphthalmia / Anophthalmia	<i>VSX2</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 40,000
Mitochondrial Complex I Deficiency (ACAD9-Related)	<i>ACAD9</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 1,800
Mitochondrial Complex I Deficiency (NDUFA11-Related)	<i>NDUFA11</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 414,000
Mitochondrial Complex I Deficiency (NDUFAF5-Related)	<i>NDUFAF5</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 98,000
Mitochondrial Complex I Deficiency (NDUFS6-Related)	<i>NDUFS6</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 353,000
Mitochondrial Complex I Deficiency (NDUFV1-Related)	<i>NDUFV1</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 870
Mitochondrial Complex I Deficiency / Leigh Syndrome (FOXRED1-Related)	<i>FOXRED1</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 13,000
Mitochondrial Complex I Deficiency / Leigh Syndrome (NDUFAF2-Related)	<i>NDUFAF2</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 168,000
Mitochondrial Complex I Deficiency / Leigh Syndrome (NDUFS4-Related)	<i>NDUFS4</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 41,000
Mitochondrial Complex IV Deficiency (COX20-related)	<i>COX20</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 42,000
Mitochondrial Complex IV Deficiency (COX6B1-related)	<i>COX6B1</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 1,116,000
Mitochondrial Complex IV Deficiency (APOPT1-Related)	<i>APOPT1</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 9,200
Mitochondrial Complex IV Deficiency (PET100-Related)	<i>PET100</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 469,000
Mitochondrial Complex IV Deficiency (SCO1-related)	<i>SCO1</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 13,000
Mitochondrial Complex IV Deficiency / Leigh Syndrome (COX10-Related)	<i>COX10</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 9,200
Mitochondrial DNA Depletion Syndrome 2	<i>TK2</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 4,900
Mitochondrial DNA Depletion Syndrome 3	<i>DGUOK</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 5,200
Mitochondrial DNA Depletion Syndrome 4A and 4B and other POLG-Related Disorders	<i>POLG</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 320
Mitochondrial DNA Depletion Syndrome 5	<i>SUCLA2</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 78,000
Mitochondrial DNA Depletion Syndrome 6 / Navajo Neurohepatopathy	<i>MPV17</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 4,400
Mitochondrial Myopathy and Sideroblastic Anemia 1	<i>PUS1</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 449,000
Mitochondrial Trifunctional Protein Deficiency (HADHB-Related)	<i>HADHB</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 3,000
Molybdenum Cofactor Deficiency A	<i>MOCS1</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 4,700

Mucopolipidosis II / IIIA	<i>GNPTAB</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 2,100
Mucopolipidosis III Gamma	<i>GNPTG</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 68,000
Mucopolipidosis IV	<i>MCOLN1</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 9,400
Mucopolysaccharidosis Type I	<i>IDUA</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 3,300
Mucopolysaccharidosis Type II	<i>IDS</i>	XL	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 76,000
Mucopolysaccharidosis Type IIIA	<i>SGSH</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 2,700
Mucopolysaccharidosis Type IIIB	<i>NAGLU</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 950
Mucopolysaccharidosis Type IIIC	<i>HGSNAT</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 3,200
Mucopolysaccharidosis Type IIID	<i>GNS</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 137,000
Mucopolysaccharidosis Type IVa	<i>GALNS</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 690
Mucopolysaccharidosis Type IVb / GM1 Gangliosidosis	<i>GLB1</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 1,700
Mucopolysaccharidosis VII	<i>GUSB</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 1,600
Mucopolysaccharidosis type IX	<i>HYAL1</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 149,000
Mucopolysaccharidosis type VI	<i>ARSB</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 1,300
Mulibrey Nanism	<i>TRIM37</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 31,000
Multiple Congenital Anomalies-Hypotonia-Seizures Syndrome 1	<i>PIGN</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 2,800
Multiple Pterygium Syndrome	<i>CHRNA3</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 9,900
Multiple Sulfatase Deficiency	<i>SUMF1</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 69,000
Muscle-Eye-Brain Disease and Other <i>POMGNT1</i> -Related Congenital Muscular Dystrophy-Dystroglycanopathies	<i>POMGNT1</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 4,200
Myoneurogastrointestinal Encephalopathy	<i>TYMP</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 2,100
Myotubular Myopathy 1	<i>MTM1</i>	XL	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 192,000
N-Acetylglutamate Synthase Deficiency	<i>NAGS</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 3,200
Nemaline Myopathy 2	<i>NEB</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 2,400
Nephrogenic Diabetes Insipidus, Type II	<i>AQP2</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 3,400
Nephrogenic Diabetes insipidus ( <i>AVPR2</i> -related) / Nephrogenic Syndrome of Inappropriate Antidiuresis	<i>AVPR2</i>	XL	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 471,000
Nephronophthisis 2	<i>INVS</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 56,000
Nephrotic Syndrome ( <i>NPHS1</i> -Related) / Congenital Finnish Nephrosis	<i>NPHS1</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 920
Nephrotic Syndrome ( <i>NPHS2</i> -Related) / Steroid-Resistant Nephrotic Syndrome	<i>NPHS2</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 780
Neurodegeneration due to Cerebral Folate Transport Deficiency	<i>FOLR1</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 5,300
Neurodevelopmental Disorder with Progressive Microcephaly, Spasticity, and Brain Anomalies	<i>PLAA</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 229,000
Neuronal Ceroid-Lipofuscinosis ( <i>CLN3</i> -Related)	<i>CLN3</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 9,200
Neuronal Ceroid-Lipofuscinosis ( <i>CLN5</i> -Related)	<i>CLN5</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 4,300
Neuronal Ceroid-Lipofuscinosis ( <i>CLN6</i> -Related)	<i>CLN6</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 8,600
Neuronal Ceroid-Lipofuscinosis ( <i>CLN8</i> -Related)	<i>CLN8</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 3,100
Neuronal Ceroid-Lipofuscinosis ( <i>MFSD8</i> -Related)	<i>MFSD8</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 6,200
Neuronal Ceroid-Lipofuscinosis ( <i>PPT1</i> -Related)	<i>PPT1</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 7,500
Neuronal Ceroid-Lipofuscinosis ( <i>TPP1</i> -Related)	<i>TPP1</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 6,300
Niemann-Pick Disease ( <i>SMPD1</i> -Related)	<i>SMPD1</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 1,800
Niemann-Pick Disease, Type C ( <i>NPC1</i> -Related)	<i>NPC1</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 690
Niemann-Pick Disease, Type C ( <i>NPC2</i> -Related)	<i>NPC2</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 6,600
Nijmegen Breakage Syndrome	<i>NBN</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 14,000
Non-Syndromic Hearing Loss ( <i>GJB2</i> -Related)	<i>GJB2</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 600
Oculocutaneous Albinism, Type IA / IB	<i>TYR</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 240
Oculocutaneous Albinism, Type IV	<i>SLC45A2</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 830

Odonto-Onycho-Dermal Dysplasia / Schopf-Schulz-Passarge Syndrome	<i>WNT10A</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 1,900
Omenn Syndrome ( <i>RAG2</i> -Related)	<i>RAG2</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 17,000
Omenn Syndrome / Severe Combined Immunodeficiency, Athabaskan-Type	<i>DCLRE1C</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 5,500
Omenn Syndrome and other <i>RAG1</i> -Related Disorders	<i>RAG1</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 850
Ornithine Aminotransferase Deficiency	<i>OAT</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 6,400
Ornithine Transcarbamylase Deficiency	<i>OTC</i>	XL	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 103,000
Osteogenesis Imperfecta, Type XI	<i>FKBP10</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 9,500
Osteopetrosis 1	<i>TCIRG1</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 4,700
Osteopetrosis 8	<i>SNX10</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 16,000
Otospondylomegapiphyseal Dysplasia / Deafness / Fibrochondrogenesis 2	<i>COL11A2</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 2,700
Papillon-Lefevre Syndrome	<i>CTSC</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 5,000
Pendred Syndrome	<i>SLC26A4</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 390
Peroxisome Biogenesis Disorder 3A and 3B	<i>PEX12</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 30,000
Peroxisome Biogenesis Disorder 7A and 7B	<i>PEX26</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 70,000
Phenylalanine Hydroxylase Deficiency	<i>PAH</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 340
Polycystic Kidney Disease, Autosomal Recessive	<i>PKHD1</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 450
Polyglandular Autoimmune Syndrome, Type 1	<i>AIRE</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 5,300
Pontocerebellar Hypoplasia, Type 1A	<i>VRK1</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 25,000
Pontocerebellar Hypoplasia, Type 1B	<i>EXOSC3</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 10,000
Pontocerebellar Hypoplasia, Type 2A and Type 4	<i>TSEN54</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 4,700
Pontocerebellar Hypoplasia, Type 2E	<i>VPS53</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 139,000
Pontocerebellar Hypoplasia, Type 6	<i>RARS2</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 8,600
Primary Carnitine Deficiency	<i>SLC22A5</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 1,500
Primary Ciliary Dyskinesia ( <i>CCDC103</i> -Related)	<i>CCDC103</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 27,000
Primary Ciliary Dyskinesia ( <i>CCDC151</i> -Related)	<i>CCDC151</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 59,000
Primary Ciliary Dyskinesia ( <i>CCDC39</i> -Related)	<i>CCDC39</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 12,000
Primary Ciliary Dyskinesia ( <i>DNAH5</i> -Related)	<i>DNAH5</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 1,500
Primary Ciliary Dyskinesia ( <i>DNAI1</i> -Related)	<i>DNAI1</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 5,000
Primary Ciliary Dyskinesia ( <i>DNAI2</i> -Related)	<i>DNAI2</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 76,000
Primary Ciliary Dyskinesia ( <i>RSPH9</i> -Related)	<i>RSPH9</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 253,000
Primary Coenzyme Q10 Deficiency 7	<i>COQ4</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 12,000
Primary Congenital Glaucoma 3A	<i>CYP1B1</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 880
Primary Hyperoxaluria, Type 1	<i>AGXT</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 1,900
Primary Hyperoxaluria, Type 2	<i>GRHPR</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 11,000
Primary Hyperoxaluria, Type 3	<i>HOGA1</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 2,400
Progressive Cerebello-Cerebral Atrophy	<i>SEPSECS</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 6,400
Progressive Familial Intrahepatic Cholestasis, Type 2	<i>ABCB11</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 950
Progressive Myoclonic Epilepsy, Type 1B	<i>PRICKLE1</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 98,000
Progressive Pseudorheumatoid Dysplasia	<i>WISP3</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 5,600
Prolidase Deficiency	<i>PEPD</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 30,000
Propionic Acidemia ( <i>PCCA</i> -Related)	<i>PCCA</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 2,600
Propionic Acidemia ( <i>PCCB</i> -Related)	<i>PCCB</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 12,000
Pulmonary Surfactant Dysfunction	<i>ABCA3</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 1,200
Pycnodysostosis	<i>CTSK</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 5,100
Pyridoxamine 5'-Phosphate Oxidase Deficiency	<i>PNPO</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 10,000
Pyridoxine-Dependent Epilepsy	<i>ALDH7A1</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 1,100

Pyruvate Carboxylase Deficiency	PC	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 8,000
Pyruvate Dehydrogenase E1-Alpha Deficiency	PDHA1	XL	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 139,000
Pyruvate Dehydrogenase E1-Beta Deficiency	PDHB	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 15,000
Renal Tubular Acidosis and Deafness	ATP6V1B1	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 6,600
Retinitis Pigmentosa 25	EYS	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 1,800
Retinitis Pigmentosa 26	CERKL	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 13,000
Retinitis Pigmentosa 28	FAM161A	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 34,000
Retinitis Pigmentosa 36	PRCD	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 304,000
Retinitis Pigmentosa 59	DHDDS	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 601,000
Retinitis Pigmentosa 64 / Bardet-Biedl Syndrome 21 / Cone-Rod Dystrophy 16	C8ORF37	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 168,000
Rh Deficiency Syndrome	RHAG	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 46,000
Rhizomelic Chondrodysplasia Punctata, Type 1	PEX7	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 10,000
Rhizomelic Chondrodysplasia Punctata, Type 3	AGPS	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 620,000
Roberts Syndrome	ESCO2	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 139,000
Salla Disease	SLC17A5	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 8,400
Salt and Pepper Developmental Regression Syndrome	ST3GAL5	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 25,000
Sandhoff Disease	HEXB	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 1,800
Schimke Immunoosseous Dysplasia	SMARCAL1	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 3,800
Seckel Syndrome 5 / Microcephaly 9	CEP152	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 1,700
Segawa Syndrome	TH	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 6,100
Sepiapterin Reductase Deficiency	SPR	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 35,000
Severe Combined Immunodeficiency (IL7R-Related)	IL7R	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 20,000
Severe Combined Immunodeficiency (JAK3-Related)	JAK3	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 2,100
Severe Combined Immunodeficiency (PTPRC-Related)	PTPRC	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 8,500
Severe Congenital Neutropenia 4	G6PC3	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 10,000
Severe Neonatal Hyperparathyroidism	CASR	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 2,700
Short Stature, Onychodysplasia, Facial Dysmorphism, and Hypotrichosis	POC1A	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 108,000
Short-Chain Acyl-CoA Dehydrogenase Deficiency	ACADS	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 660
Shwachman-Diamond Syndrome	SBDS	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 1,700
Sialidosis, Type I and Type II	NEU1	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 2,000
Sjogren-Larsson Syndrome	ALDH3A2	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 5,500
Smith-Lemli-Opitz Syndrome	DHCR7	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 750
Spastic Paraplegia 15	ZFYVE26	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 46,000
Spastic Tetraplegia, Thin Corpus Callosum, and Progressive Microcephaly	SLC1A4	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 855,000
Spherocytosis, Type 5	EPB42	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 3,200
Spinal Muscular Atrophy	SMN1	AR	Reduced Risk	SMN1 copy number: 2 SMN2 copy number: 0 c.*3>80T>G: Negative SMN1 Sequencing: Negative <b>Personalized Residual Risk:</b> 1 in 1,107
Spinal Muscular Atrophy with Respiratory Distress 1 / Charcot-Marie-Tooth Disease, Type 2S	IGHMBP2	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 1,200
Spinocerebellar Ataxia with Axonal Neuropathy 3	COA7	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 12,000
Spondylocostal Dysostosis 1	DLL3	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 7,200
Spondylometaphyseal Dysplasia (DDR2-Related)	DDR2	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 236,000
Spondylothoracic Dysostosis	MESP2	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 382,000

Steel Syndrome	COL27A1	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 93,000
Stuve-Wiedemann Syndrome	LIFR	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 6,000
Sulfate Transporter-Related Osteochondrodysplasia	SLC26A2	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 1,800
Tay-Sachs Disease	HEXA	AR	Reduced Risk	Tay-Sachs disease enzyme: Non-carrier White blood cells: Non-carrier <ul style="list-style-type: none"> <li>Hex A%: 59.5% (Non-carrier : 55.0 - 72.0%; Carrier: &lt;50%)</li> <li>Total hexosaminidase activity: 2772 nmol/hr/mg</li> </ul> Plasma: Non-carrier <ul style="list-style-type: none"> <li>Hex A%: 66.3 (Non-carrier : 58.0 - 72.0%; Carrier: &lt;54%)</li> <li>Total hexosaminidase activity: 438 nmol/hr/ml</li> </ul> HEXA Sequencing: Negative <b>Personalized Residual Risk:</b> 1 in 1,400
Thiamine-Responsive Megaloblastic Anemia Syndrome	SLC19A2	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 11,000
Thyroid Dysmorphogenesis 1	SLC5A5	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 45,000
Thyroid Dysmorphogenesis 2A	TPO	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 910
Thyroid Dysmorphogenesis 3	TG	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 850
Thyroid Dysmorphogenesis 4	IYD	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 1,800
Thyroid Dysmorphogenesis 5	DUOXA2	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 29,000
Thyroid Dysmorphogenesis 6	DUOX2	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 190
Trichohepatoenteric Syndrome 1	TTC37	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 14,000
Tyrosinemia, Type I	FAH	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 1,900
Tyrosinemia, Type II	TAT	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 4,800
Tyrosinemia, Type III	HPD	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 266,000
Usher Syndrome, Type IB	MYO7A	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 1,000
Usher Syndrome, Type IC	USH1C	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 1,600
Usher Syndrome, Type ID	CDH23	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 1,400
Usher Syndrome, Type IF	PCDH15	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 3,800
Usher Syndrome, Type IIA	USH2A	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 290
Usher Syndrome, Type III	CLRN1	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 1,300
Very Long Chain Acyl-CoA Dehydrogenase Deficiency	ACADVL	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 920
Vitamin D-Dependent Rickets, Type I	CYP27B1	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 7,900
Vitamin D-Resistant Rickets, Type IIA	VDR	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 17,000
Walker-Warburg Syndrome and Other FKTN-Related Dystrophies	FKTN	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 4,200
Werner Syndrome	WRN	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 9,200
Wilson Disease	ATP7B	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 350
Wiskott-Aldrich Syndrome (WAS-Related)	WAS	XL	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 1,203,000
Wolcott-Rallison Syndrome	EIF2AK3	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 22,000
Wolman Disease / Cholesteryl Ester Storage Disease	LIPA	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 3,200
Woodhouse-Sakati Syndrome	DCAF17	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 81,000
X-Linked Juvenile Retinoschisis	RS1	XL	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 40,000
X-Linked Severe Combined Immunodeficiency	IL2RG	XL	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 250,000
Xeroderma Pigmentosum (POLH-Related)	POLH	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 5,900
Xeroderma Pigmentosum, Group A	XPA	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 11,000
Xeroderma Pigmentosum, Group C	XPC	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 12,000

<b>Xeroderma Pigmentosum, Group G</b>	<i>ERCC5</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 3,000
<b>Zellweger Syndrome Spectrum (PEX10-Related)</b>	<i>PEX10</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 6,300
<b>Zellweger Syndrome Spectrum (PEX1-Related)</b>	<i>PEX1</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 2,000
<b>Zellweger Syndrome Spectrum (PEX2-Related)</b>	<i>PEX2</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 77,000
<b>Zellweger Syndrome Spectrum (PEX6-Related)</b>	<i>PEX6</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 1,600

AR=Autosomal recessive; XL=X-linked

## Test methods and comments

Genomic DNA isolated from this patient was analyzed by one or more of the following methodologies, as applicable:

### Fragile X CGG Repeat Analysis (Analytical Detection Rate >99%)

PCR amplification using Asuragen, Inc. AmplideX<sup>®</sup> *FMR1* PCR reagents followed by capillary electrophoresis for allele sizing was performed. Samples positive for *FMR1* CGG repeats in the premutation and full mutation size range were further analyzed by Southern blot analysis to assess the size and methylation status of the *FMR1* CGG repeat.

### Genotyping (Analytical Detection Rate >99%)

Multiplex PCR amplification and allele specific primer extension analyses using the MassARRAY<sup>®</sup> System were used to identify certain recurrent variants that are complex in nature or are present in low copy repeats. Rare sequence variants may interfere with assay performance.

### Multiplex Ligation-Dependent Probe Amplification (MLPA) (Analytical Detection Rate >99%)

MLPA<sup>®</sup> probe sets and reagents from MRC-Holland were used for copy number analysis of specific targets versus known control samples. False positive or negative results may occur due to rare sequence variants in target regions detected by MLPA probes. Analytical sensitivity and specificity of the MLPA method are both 99%.

For alpha thalassemia, the copy numbers of the *HBA1* and *HBA2* genes were analyzed. Alpha-globin gene deletions, triplications, and the Constant Spring (CS) mutation are assessed. This test is expected to detect approximately 90% of all alpha-thalassemia mutations, varying by ethnicity, carriers of alpha-thalassemia with three or more *HBA* copies on one chromosome, and one or no copies on the other chromosome, may not be detected. With the exception of triplications, other benign alpha-globin gene polymorphisms will not be reported. Analyses of *HBA1* and *HBA2* are performed in association with long-range PCR of the coding regions followed by short-read sequencing.

For Duchenne muscular dystrophy, the copy numbers of all *DMD* exons were analyzed. Potentially pathogenic single exon deletions and duplications are confirmed by a second method. Analysis of *DMD* is performed in association with sequencing of the coding regions.

For congenital adrenal hyperplasia, the copy number of the *CYP21A2* gene was analyzed. This analysis can detect large deletions typically due to unequal meiotic crossing-over between *CYP21A2* and the pseudogene *CYP21A1P*. Classic 30-kb deletions make up approximately 20% of *CYP21A2* pathogenic alleles. This test may also identify certain point mutations in *CYP21A2* caused by gene conversion events between *CYP21A2* and *CYP21A1P*. Some carriers may not be identified by dosage sensitive methods as this testing cannot detect individuals with two copies (duplication) of the *CYP21A2* gene on one chromosome and loss of *CYP21A2* (deletion) on the other chromosome. Analysis of *CYP21A2* is performed in association with long-range PCR of the coding regions followed by short-read sequencing.

For spinal muscular atrophy (SMA), the copy numbers of the *SMN1* and *SMN2* genes were analyzed. The individual dosage of exons 7 and 8 as well as the combined dosage of exons 1, 4, 6 and 8 of *SMN1* and *SMN2* were assessed. Copy number gains and losses can be detected with this assay. Depending on ethnicity, 6 - 29 % of carriers will not be identified by dosage sensitive methods as this testing cannot detect individuals with two copies (duplication) of the *SMN1* gene on one chromosome and loss of *SMN1* (deletion) on the other chromosome (silent 2+0 carrier) or individuals that carry an intragenic mutation in *SMN1*. Please also note that 2% of individuals diagnosed with SMA have a causative *SMN1* variant that occurred *de novo*, and therefore cannot be picked up by carrier screening in the parents. Analysis of *SMN1* is performed in association with short-read sequencing of exons 2a-7, followed by confirmation using long-range PCR (described below).

The presence of the c.\*3+80T>G (chr5:70,247,901T>G) variant allele in an individual with Ashkenazi Jewish or Asian ancestry is typically indicative of a duplication of *SMN1*. When present in an Ashkenazi Jewish or Asian individual with two copies of *SMN1*, c.\*3+80T>G is likely indicative of a silent (2+0) carrier. In individuals with two copies of *SMN1* with African American, Hispanic or Caucasian ancestry, the presence or absence of c.\*3+80T>G significantly increases or decreases, respectively, the likelihood of being a silent 2+0 carrier.

MLPA for Gaucher disease (*GBA*), cystic fibrosis (*CFTR*), and non-syndromic hearing loss (*GJB2/GJB6*) will only be performed if indicated for confirmation of detected CNVs. If *GBA* analysis was performed, the copy numbers of exons 1, 3, 4, and 6 - 10 of the *GBA* gene (of 11 exons total) were analyzed. If *CFTR* analysis was performed, the copy numbers of all 27 *CFTR* exons were analyzed. If *GJB2/GJB6* analysis was performed,



the copy number of the two *GJB2* exons were analyzed, as well as the presence or absence of the two upstream deletions of the *GJB2* regulatory region, del(*GJB6*-D13S1830) and del(*GJB6*-D13S1854).

#### Next Generation Sequencing (NGS) (Analytical Detection Rate >95%)

NGS was performed on a panel of genes for the purpose of identifying pathogenic or likely pathogenic variants.

Agilent SureSelect<sup>TM</sup>XT Low Input technology was used with a custom capture library to target the exonic regions and intron/exon splice junctions of the relevant genes, as well as a number of UTR, intronic or promoter regions that contain previously reported mutations. Libraries were pooled and sequenced on the Illumina NovaSeq 9000 platform, using paired-end 100 bp reads. The sequencing data was analyzed using a custom bioinformatics algorithm designed and validated in house.

The coding exons and splice junctions of the known protein-coding RefSeq genes were assessed for the average depth of coverage (minimum of 20X) and data quality threshold values. Most exons not meeting a minimum of >20X read depth across the exon are further analyzed by Sanger sequencing. Please note that several genomic regions present difficulties in mapping or obtaining read depth >20X. These regions, which are described below, will not be reflexed to Sanger sequencing if the mapping quality or coverage is poor. Any variants identified during testing in these regions are confirmed by a second method and reported if determined to be pathogenic or likely pathogenic. However, as there is a possibility of false negative results within these regions, detection rates and residual risks for these genes have been calculated with the presumption that variants in these exons will not be detected, unless included in the MassARRAY<sup>®</sup> genotyping platform.

**Exceptions:** *ABCD1* (NM\_000033.3) exons 8 and 9; *ACADSB* (NM\_001609.3) chr10:124,810,695-124,810,707 (partial exon 9); *ADA* (NM\_000022.2) exon 1; *ADAMTS2* (NM\_014244.4) exon 1; *AGPS* (NM\_003659.3) chr2:178,257,512-178,257,649 (partial exon 1); *ALDH7A1* (NM\_001182.4) chr5:125,911,150-125,911,163 (partial exon 7) and chr5:125,896,807-125,896,821 (partial exon 10); *ALMS1* (NM\_015120.4) chr2:73,612,990-73,613,041 (partial exon 1); *APOPT1* (NM\_032374.4) chr14:104,040,437-104,040,455 (partial exon 3); *CDAN1* (NM\_138477.2) exon 2; *CEP152* (NM\_014985.3) chr15:49,061,146-49,061,165 (partial exon 14) and exon 22; *CEP290* (NM\_025114.3) exon 5, exon 7, chr12:88,519,017-88,519,039 (partial exon 13), chr12:88,514,049-88,514,058 (partial exon 15), chr12:88,502,837-88,502,841 (partial exon 23), chr12:88,481,551-88,481,589 (partial exon 32), chr12:88,471,605-88,471,700 (partial exon 40); *CFTR* (NM\_000492.3) exon 10; *COL4A4* (NM\_000092.4) chr2:227,942,604-227,942,619 (partial exon 25); *COX10* (NM\_001303.3) exon 6; *CYP11B1* (NM\_000497.3) exons 3-7; *CYP11B2* (NM\_000498.3) exons 3-7; *DNAI2* (NM\_023036.4) chr17:72,308,136-72,308,147 (partial exon 12); *DOK7* (NM\_173660.4) chr4:3,465,131-3,465,161 (partial exon 1) and exon 2; *DUOX2* (NM\_014080.4) exons 6-8; *EIF2AK3* (NM\_004836.5) exon 8; *EVC* (NM\_153717.2) exon 1; *FH* (NM\_000143.3) exon 1; *GAMT* (NM\_000156.5) exon 1; *GLDC* (NM\_000170.2) exon 1; *GNPTAB* (NM\_024312.4) chr17:4,837,000-4,837,400 (partial exon 2); *GNPTG* (NM\_032520.4) exon 1; *GHR* (NM\_000163.4) exon 3; *GYS2* (NM\_021957.3) chr12:21,699,370-21,699,409 (partial exon 12); *HGSNAT* (NM\_152419.2) exon 1; *IDS* (NM\_000202.6) exon 3; *ITGB4* (NM\_000213.4) chr17:73,749,976-73,750,060 (partial exon 33); *JAK3* (NM\_000215.3) chr19:17,950,462-17,950,483 (partial exon 10); *LIFR* (NM\_002310.5) exon 19; *LMBRD1* (NM\_018368.3) chr6:70,459,226-70,459,257 (partial exon 5), chr6:70,447,828-70,447,836 (partial exon 7) and exon 12; *LYST* (NM\_000081.3) chr1:235,944,158-235,944,176 (partial exon 16) and chr1:235,875,350-235,875,362 (partial exon 43); *MLYCD* (NM\_012213.2) chr16:83,933,242-83,933,282 (partial exon 1); *MTR* (NM\_000254.2) chr1 237,024,418-237,024,439 (partial exon 20) and chr1:237,038,019-237,038,029 (partial exon 24); *NBEAL2* (NM\_015175.2) chr3 47,021,385-47,021,407 (partial exon 1); *NEB* (NM\_001271208.1) exons 82-105; *NPC1* (NM\_000271.4) chr18:21,123,519-21,123,538 (partial exon 14); *NPHP1* (NM\_000272.3) chr2:110,937,251-110,937,263 (partial exon 3); *OCRL* (NM\_000276.3) chrX:128,674,450-128,674,460 (partial exon 1); *PHKB* (NM\_000293.2) exon 1 and chr16:47,732,498-47,732,504 (partial exon 30); *PIGN* (NM\_176787.4) chr18:59,815,547-59,815,576 (partial exon 8); *PIP5K1C* (NM\_012398.2) exon 1 and chr19:3637602-3637616 (partial exon 17); *POU1F1* (NM\_000306.3) exon 5; *PTPRC* (NM\_002838.4) exons 11 and 23; *PUS1* (NM\_025215.5) chr12:132,414,446-132,414,532 (partial exon 2); *RPGRIP1L* (NM\_015272.2) exon 23; *SGSH* (NM\_000199.3) chr17:78,194,022-78,194,072 (partial exon 1); *SLC6A8* (NM\_005629.3) exons 3 and 4; *ST3GAL5* (NM\_003896.3) exon 1; *SURF1* (NM\_003172.3) chr9:136,223,269-136,223,307 (partial exon 1); *TRPM6* (NM\_017662.4) chr9:77,362,800-77,362,811 (partial exon 31); *TSEN54* (NM\_207346.2) exon 1; *TYR* (NM\_000372.4) exon 5; *VWF* (NM\_000552.3) exons 24-26, chr12:6,125,675-6,125,684 (partial exon 30), chr12:6,121,244-6,121,265 (partial exon 33), and exon 34.

This test will detect variants within the exons and the intron-exon boundaries of the target regions. Variants outside these regions may not be detected, including, but not limited to, UTRs, promoters, and deep intronic areas, or regions that fall into the Exceptions mentioned above. This technology may not detect all small insertion/deletions and is not diagnostic for repeat expansions and structural genomic variation. In addition, a mutation(s) in a gene not included on the panel could be present in this patient.

Variant interpretation and classification was performed based on the American College of Medical Genetics Standards and Guidelines for the Interpretation of Sequence Variants (Richards et al, 2015). All potentially pathogenic variants may be confirmed by either a specific genotyping assay or Sanger sequencing, if indicated. Any benign variants, likely benign variants or variants of uncertain significance identified during this analysis will not be reported.

#### Next Generation Sequencing for SMN1

Exonic regions and intron/exon splice junctions of *SMN1* and *SMN2* were captured, sequenced, and analyzed as described above. Any variants located within exons 2a-7 and classified as pathogenic or likely pathogenic were confirmed to be in either *SMN1* or *SMN2* using gene-specific long-range PCR analysis followed by Sanger sequencing. Variants located in exon 1 cannot be accurately assigned to either *SMN1* or *SMN2* using our current methodology, and so these variants are considered to be of uncertain significance and are not reported.

#### Copy Number Variant Analysis (Analytical Detection Rate >95%)

Large duplications and deletions were called from the relative read depths on an exon-by-exon basis using a custom exome hidden Markov model (XHMM) algorithm. Deletions or duplications determined to be pathogenic or likely pathogenic were confirmed by either a custom arrayCGH platform, quantitative PCR, or MLPA (depending on CNV size and gene content). While this algorithm is designed to pick up deletions and duplications of 2 or more exons in length, potentially pathogenic single-exon CNVs will be confirmed and reported, if detected.

#### Exon Array (Confirmation method) (Accuracy >99%)

The customized oligonucleotide microarray (Oxford Gene Technology) is a highly-targeted exon-focused array capable of detecting medically relevant microdeletions and microduplications at a much higher resolution than traditional aCGH methods. Each array matrix has approximately 180,000 60-mer oligonucleotide probes that cover the entire genome. This platform is designed based on human genome NCBI Build 37 (hg19) and the CGH probes are enriched to target the exonic regions of the genes in this panel.

#### Quantitative PCR (Confirmation method) (Accuracy >99%)

Th relative quantification PCR is utilized on a Roche Universal Library Probe (UPL) system, which relates the PCR signal of the target region in one group to another. To test for genomic imbalances, both sample DNA and reference DNA is amplified with primer/probe sets that specific to the target region and a control region with known genomic copy number. Relative genomic copy numbers are calculated based on the standard  $\Delta\Delta C_t$  formula.

#### Long-Range PCR (Analytical Detection Rate >99%)

Long-range PCR was performed to generate locus-specific amplicons for *CYP21A2*, *HBA1* and *HBA2* and *GBA*. The PCR products were then prepared for short-read NGS sequencing and sequenced. Sequenced reads were mapped back to the original genomic locus and run through the bioinformatics pipeline. If indicated, copy number from MLPA was correlated with the sequencing output to analyze the results. For *CYP21A2*, a certain percentage of healthy individuals carry a duplication of the *CYP21A2* gene, which has no clinical consequences. In cases where two copies of a gene are located on the same chromosome in tandem, only the second copy will be amplified and assessed for potentially pathogenic variants, due to size limitations of the PCR reaction. However, because these alleles contain at least two copies of the *CYP21A2* gene in tandem, it is expected that this patient has at least one functional gene in the tandem allele and this patient is therefore less likely to be a carrier. When an individual carries both a duplication allele and a pathogenic variant, or multiple pathogenic variants, the current analysis may not be able to determine the phase (cis/trans configuration) of the *CYP21A2* alleles identified. Family studies may be required in certain scenarios where phasing is required to determine the carrier status.

#### Residual Risk Calculations

Carrier frequencies and detection rates for each ethnicity were calculated through the combination of internal curations of >30,000 variants and genomic frequency data from >138,000 individuals across seven ethnic groups in the gnomAD database. Additional variants in HGMD and novel deleterious variants were also incorporated into the calculation. Residual risk values are calculated using a Bayesian analysis combining the *a priori* risk of being a pathogenic mutation carrier (carrier frequency) and the detection rate. They are provided only as a guide for assessing approximate risk given a negative result, and values will vary based on the exact ethnic background of an individual. This report does not represent medical advice but should be interpreted by a genetic counselor, medical geneticist or physician skilled in genetic result interpretation and the relevant medical literature.

#### Personalized Residual Risk Calculations

Agilent SureSelect<sup>TM</sup>XT Low-Input technology was utilized in order to create whole-genome libraries for each patient sample. Libraries were then pooled and sequenced on the Illumina NovaSeq platform. Each sequencing lane was multiplexed to achieve 0.4-2x genome coverage, using paired-end 100 bp reads. The sequencing data underwent ancestral analysis using a customized, licensed bioinformatics algorithm that was validated in house. Identified sub-ethnic groupings were binned into one of 7 continental-level groups (African, East Asian, South Asian, Non-Finnish European, Finnish, Native American, and Ashkenazi Jewish) or, for those ethnicities that matched poorly to the continental-level groups, an 8<sup>th</sup> "unassigned" group, which were then used to select residual risk values for each gene. For individuals belonging to multiple high-level ethnic groupings, a weighting strategy was used to select the most appropriate residual risk. For genes that had insufficient data to calculate ethnic-specific residual risk values, or for sub-ethnic groupings that fell into the "unassigned" group, a "worldwide" residual risk was used. This "worldwide" residual risk was calculated using data from all available continental-level groups.

#### Sanger Sequencing (Confirmation method) (Accuracy >99%)

Sanger sequencing, as indicated, was performed using BigDye Terminator chemistry with the ABI 3730 DNA analyzer with target specific amplicons. It also may be used to supplement specific guaranteed target regions that fail NGS sequencing due to poor quality or low depth of coverage (<20 reads) or as a confirmatory method for NGS positive results. False negative results may occur if rare variants interfere with amplification or annealing.

#### **Tay-Sachs Disease (TSD) Enzyme Analysis (Analytical Detection Rate $\geq$ 98%)**

Hexosaminidase activity and Hex A% activity were measured by a standard heat-inactivation, fluorometric method using artificial 4-MU- $\beta$ -N-acetyl glucosaminide (4-MUG) substrate. This assay is highly sensitive and accurate in detecting Tay-Sachs carriers and individuals affected with TSD. Normal ranges of Hex A% activity are 55.0-72.0 for white blood cells and 58.0-72.0 for plasma. It is estimated that less than 0.5% of Tay-Sachs carriers have non-carrier levels of percent Hex A activity, and therefore may not be identified by this assay. In addition, this assay may detect individuals that are carriers of or are affected with Sandhoff disease. False positive results may occur if benign variants, such as pseudodeficiency alleles, interfere with the enzymatic assay. False negative results may occur if both *HEXA* and *HEXB* pathogenic or pseudodeficiency variants are present in the same individual.

Please note these tests were developed and their performance characteristics were determined by Sema4 Opco, Inc. They have not been cleared or approved by the FDA. These analyses generally provide highly accurate information regarding the patient's carrier or affected status. Despite this high level of accuracy, it should be kept in mind that there are many potential sources of diagnostic error, including misidentification of samples, polymorphisms, or other rare genetic variants that interfere with analysis. Families should understand that rare diagnostic errors may occur for these reasons.

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Additional disease-specific references available upon request.