



## Donor 6481

### Genetic Testing Summary

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

Last Updated: 03/17/23

Donor Reported Ancestry: German, Bohemian, English, Swedish

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 in the attached report.	<b>Carrier: Biotinidase Deficiency (BTD)</b>  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 6481  
 Date of Birth: [REDACTED]  
 Sema4 ID: [REDACTED]  
 Client ID: [REDACTED]  
 Indication: Carrier Screening

**Specimen Information**

Specimen Type: Blood  
 Date Collected: 07/25/2022  
 Date Received: 07/26/2022  
 Final Report: 08/05/2022

**Referring Provider**

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

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

### SUMMARY OF RESULTS AND RECOMMENDATIONS

⊕ Positive	⊖ Negative
<p><b>Carrier of Biotinidase Deficiency (AR)</b>            Associated gene(s): <i>BTD</i>            Variant(s) Detected: c.1330G&gt;C, p.D444H, Pathogenic,            Heterozygous (one copy)</p>	<p><b>Negative for all other genes tested</b>            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.
- 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. Please note that residual risks for X-linked diseases (including full repeat expansions for Fragile X syndrome) may not be accurate for males and the actual residual risk is likely to be lower.

## Interpretation of positive results

**Biotinidase Deficiency (AR)**

**Results and Interpretation**

A heterozygous (one copy) pathogenic missense variant, c.1330G>C, p.D444H, was detected in the *BTD* gene (NM\_000060.3). Please note that this is a mild variant and is not expected to result in a disease phenotype when homozygous, unless present as part of a complex allele. If found in trans with a severe pathogenic variant, the individual is expected to develop partial biotinidase deficiency. When this variant is present in trans with a pathogenic variant, it is considered to be causative for biotinidase deficiency. Therefore, this individual is expected to be at least a carrier for biotinidase deficiency. Heterozygous carriers are not expected to exhibit symptoms of this disease.

**What is Biotinidase Deficiency?**

Biotinidase deficiency is an autosomal recessive disorder caused by pathogenic variants in the gene *BTD*. This pan-ethnic disorder affects individuals within the first few months of life. Severe forms of the disorder cause children to experience neurological abnormalities such as seizures, hypotonia, developmental delay, and vision problems as well as hearing problems, respiratory problems, and cutaneous abnormalities. While effective treatment is available, symptoms such as vision problems, hearing loss, and developmental delay are



irreversible. Several specific variants have been associated with full or partial biotinidase deficiency, and therefore the severity of the disease may be predicted based on the genotype.

## 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.

**Juliette J. Kahle, Ph.D., FACMG, Assistant 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>Biotinidase Deficiency</b>	<i>BTBD</i>	AR	Carrier	c.1330G>C, p.D444H, 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>Agenesis 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	HBA1 Copy Number: 2 HBA2 Copy Number: 2 No pathogenic copy number variants detected HBA1/HBA2 Sequencing: Negative <b>Personalized Residual Risk:</b> 1 in 10,000
<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 (COL4A4-Related)	COL4A4	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 1,800
Alport Syndrome (COL4A5-Related)	COL4A5	XL	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 150,000
Alstrom Syndrome	ALMS1	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 3,800
Andermann Syndrome	SLC12A6	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 151,000
Antley-Bixler Syndrome (POR-Related)	POR	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 4,000
Argininemia	ARG1	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 6,500
Argininosuccinic Aciduria	ASL	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 1,200
Aromatase Deficiency	CYP19A1	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 5,400
Arthrogryposis, Intellectual Disability, and Seizures	SLC35A3	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 454,000
Asparagine Synthetase Deficiency	ASNS	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 202,000
Aspartylglycosaminuria	AGA	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 13,000
Ataxia With Isolated Vitamin E Deficiency	TTPA	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 61,000
Ataxia-Telangiectasia	ATM	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 1,300
Ataxia-Telangiectasia-Like Disorder 1	MRE11	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 5,500
Autosomal Recessive Spastic Ataxia of Charlevoix-Saguenay	SACS	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 2,600
Bardet-Biedl Syndrome (ARL6-Related)	ARL6	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 29,000
Bardet-Biedl Syndrome (BBS10-Related)	BBS10	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 2,700
Bardet-Biedl Syndrome (BBS12-Related)	BBS12	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 9,900
Bardet-Biedl Syndrome (BBS1-Related)	BBS1	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 6,400
Bardet-Biedl Syndrome (BBS2-Related)	BBS2	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 1,200
Bardet-Biedl Syndrome (BBS4-Related)	BBS4	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 22,000
Bare Lymphocyte Syndrome, Type II	CIITA	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 35,000
Barth Syndrome	TAZ	XL	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 183,000
Bartter Syndrome, Type 3	CLCNKB	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 740
Bartter Syndrome, Type 4A	BSND	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 91,000
Bernard-Soulier Syndrome, Type A1	GP1BA	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 42,000
Bernard-Soulier Syndrome, Type C	GP9	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 3,300
Beta-Globin-Related Hemoglobinopathies	HBB	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	ACAT1	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 5,400
Beta-Mannosidosis	MANBA	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 9,100
BH4-Deficient Hyperphenylalaninemia C	QDPR	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 3,100
BH4-Deficient Hyperphenylalaninemia D	PCBD1	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 8,000
Bilateral Frontoparietal Polymicrogyria	GPR56	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 203,000
Bloom Syndrome	BLM	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 7,400
Canavan Disease	ASPA	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 4,000
Carbamoylphosphate Synthetase I Deficiency	CPS1	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 1,100
Carnitine Acylcarnitine Translocase Deficiency	SLC25A20	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 4,100
Carnitine Palmitoyltransferase IA Deficiency	CPT1A	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 24,000
Carnitine Palmitoyltransferase II Deficiency	CPT2	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 670
Carpenter Syndrome	RAB23	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 21,000
Cartilage-Hair Hypoplasia	RMRP	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 960
Catecholaminergic Polymorphic Ventricular Tachycardia	CASQ2	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 5,900
Central Hypothyroidism and Testicular Enlargement	IGSF1	XL	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 781,000



Cerebral Creatine Deficiency Syndrome 1	SLC6A8	XL	Reduced Risk	Personalized Residual Risk: 1 in 208,000
Cerebral Creatine Deficiency Syndrome 2	GAMT	AR	Reduced Risk	Personalized Residual Risk: 1 in 2,100
Cerebral Creatine Deficiency Syndrome 3	GATM	AR	Reduced Risk	Personalized Residual Risk: 1 in 7900
Cerebral Dysgenesis, Neuropathy, Ichthyosis, and Palmoplantar Keratoderma Syndrome	SNAP29	AR	Reduced Risk	Personalized Residual Risk: 1 in 1,730,000
Cerebrotendinous Xanthomatosis	CYP27A1	AR	Reduced Risk	Personalized Residual Risk: 1 in 3,900
Charcot-Marie-Tooth Disease, Type 4D	NDRG1	AR	Reduced Risk	Personalized Residual Risk: 1 in 730,000
Charcot-Marie-Tooth Disease, Type 5 / Arts Syndrome	PRPS1	XL	Reduced Risk	Personalized Residual Risk: 1 in 114,000
Charcot-Marie-Tooth Disease, X-Linked	GJB1	XL	Reduced Risk	Personalized Residual Risk: 1 in 11,000
Chediak-Higashi Syndrome	LYST	AR	Reduced Risk	Personalized Residual Risk: 1 in 7,100
Chondrodysplasia Punctata	ARSE	XL	Reduced Risk	Personalized Residual Risk: 1 in 862,000
Choreoacanthocytosis	VPS13A	AR	Reduced Risk	Personalized Residual Risk: 1 in 13,000
Choroideremia	CHM	XL	Reduced Risk	Personalized Residual Risk: 1 in 125,000
Chronic Granulomatous Disease (CYBA-Related)	CYBA	AR	Reduced Risk	Personalized Residual Risk: 1 in 5,000
Chronic Granulomatous Disease (CYBB-Related)	CYBB	XL	Reduced Risk	Personalized Residual Risk: 1 in 294,000
Citrin Deficiency	SLC25A13	AR	Reduced Risk	Personalized Residual Risk: 1 in 12,000
Citrullinemia, Type 1	ASS1	AR	Reduced Risk	Personalized Residual Risk: 1 in 2,500
Cockayne Syndrome, Type A	ERCC8	AR	Reduced Risk	Personalized Residual Risk: 1 in 8,900
Cockayne Syndrome, Type B and other ERCC6-Related Disorders	ERCC6	AR	Reduced Risk	Personalized Residual Risk: 1 in 8,100
Cohen Syndrome	VPS13B	AR	Reduced Risk	Personalized Residual Risk: 1 in 6,400
Combined Factor V and VIII Deficiency	LMAN1	AR	Reduced Risk	Personalized Residual Risk: 1 in 102,000
Combined Malonic and Methylmalonic Aciduria	ACSF3	AR	Reduced Risk	Personalized Residual Risk: 1 in 2,400
Combined Oxidative Phosphorylation Deficiency 1	GFM1	AR	Reduced Risk	Personalized Residual Risk: 1 in 13,000
Combined Oxidative Phosphorylation Deficiency 3	TSFM	AR	Reduced Risk	Personalized Residual Risk: 1 in 27,000
Combined Pituitary Hormone Deficiency 1	POU1F1	AR	Reduced Risk	Personalized Residual Risk: 1 in 3,900
Combined Pituitary Hormone Deficiency 2	PROP1	AR	Reduced Risk	Personalized Residual Risk: 1 in 2,800
Combined Pituitary Hormone Deficiency 3	LHX3	AR	Reduced Risk	Personalized Residual Risk: 1 in 140,000
Combined SAP Deficiency	PSAP	AR	Reduced Risk	Personalized Residual Risk: 1 in 44,000
Cone-Rod Dystrophy 6 / Leber Congenital Amaurosis 1	GUCY2D	AR	Reduced Risk	Personalized Residual Risk: 1 in 1,200
Congenital Adrenal Hyperplasia due to 11-Beta-Hydroxylase Deficiency	CYP11B1	AR	Reduced Risk	Personalized Residual Risk: 1 in 520
Congenital Adrenal Hyperplasia due to 17-Alpha-Hydroxylase Deficiency	CYP17A1	AR	Reduced Risk	Personalized Residual Risk: 1 in 1,800
Congenital Adrenal Hyperplasia due to 21-Hydroxylase Deficiency	CYP21A2	AR	Reduced Risk	<p>CYP21A2 copy number: 2 CYP21A2 sequencing: Negative</p> <p>Personalized Residual Risk (Congenital Adrenal Hyperplasia due to 21-Hydroxylase Deficiency (Non-Classic)): 1 in 200</p> <p>Personalized Residual Risk (Congenital Adrenal Hyperplasia due to 21-Hydroxylase Deficiency (Classic)): 1 in 1,300</p>
Congenital Adrenal Hypoplasia (NR0B1-Related)	NR0B1	XL	Reduced Risk	Personalized Residual Risk: 1 in 353,000
Congenital Adrenal Insufficiency (CYP11A1-Related)	CYP11A1	AR	Reduced Risk	Personalized Residual Risk: 1 in 6,100
Congenital Amegakaryocytic Thrombocytopenia	MPL	AR	Reduced Risk	Personalized Residual Risk: 1 in 3,100
Congenital Bile Acid Synthesis Defect (AKR1D1-Related)	AKR1D1	AR	Reduced Risk	Personalized Residual Risk: 1 in 6,900
Congenital Bile Acid Synthesis Defect (HSD3B7-Related)	HSD3B7	AR	Reduced Risk	Personalized Residual Risk: 1 in 8,900
Congenital Disorder of Deglycosylation	NGLY1	AR	Reduced Risk	Personalized Residual Risk: 1 in 14,000
Congenital Disorder of Glycosylation, Type Ia	PMM2	AR	Reduced Risk	Personalized Residual Risk: 1 in 540
Congenital Disorder of Glycosylation, Type Ib	MPI	AR	Reduced Risk	Personalized Residual Risk: 1 in 5,600

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





Factor IX Deficiency	<i>F9</i>	XL	Reduced Risk	Personalized Residual Risk: 1 in 5,100
Factor VII Deficiency	<i>F7</i>	AR	Reduced Risk	Personalized Residual Risk: 1 in 450
Factor XI Deficiency	<i>F11</i>	AR	Reduced Risk	Personalized Residual Risk: 1 in 1,500
Familial Autosomal Recessive Hypercholesterolemia	<i>LDLRAP1</i>	AR	Reduced Risk	Personalized Residual Risk: 1 in 136,000
Familial Dysautonomia	<i>IKBKAP</i>	AR	Reduced Risk	Personalized Residual Risk: 1 in 51,000
Familial Hypercholesterolemia	<i>LDLR</i>	AR	Reduced Risk	Personalized Residual Risk: 1 in 280
Familial Hyperinsulinemic Hypoglycemia 4 / 3-Hydroxyacyl-CoA Dehydrogenase Deficiency	<i>HADH</i>	AR	Reduced Risk	Personalized Residual Risk: 1 in 9,200
Familial Hyperinsulinism (ABCC8-Related)	<i>ABCC8</i>	AR	Reduced Risk	Personalized Residual Risk: 1 in 450
Familial Hyperinsulinism (KCNJ11-Related)	<i>KCNJ11</i>	AR	Reduced Risk	Personalized Residual Risk: 1 in 5,300
Familial Hyperphosphatemic Tumoral Calcinosis	<i>GALNT3</i>	AR	Reduced Risk	Personalized Residual Risk: 1 in 7,800
Familial Mediterranean Fever	<i>MEFV</i>	AR	Reduced Risk	Personalized Residual Risk: 1 in 1,200
Fanconi Anemia, Group A	<i>FANCA</i>	AR	Reduced Risk	Personalized Residual Risk: 1 in 1,100
Fanconi Anemia, Group C	<i>FANCC</i>	AR	Reduced Risk	Personalized Residual Risk: 1 in 12,000
Fanconi Anemia, Group G	<i>FANCG</i>	AR	Reduced Risk	Personalized Residual Risk: 1 in 28,000
Fanconi-Bickel Syndrome	<i>SLC2A2</i>	AR	Reduced Risk	Personalized Residual Risk: 1 in 4,000
Fragile X Syndrome	<i>FMR1</i>	XL	Reduced Risk	<i>FMR1</i> CGG repeat sizes: Not Performed <i>FMR1</i> 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. Personalized Residual Risk: 1 in 19,000
Fructose-1,6-Bisphosphatase Deficiency	<i>FBP1</i>	AR	Reduced Risk	Personalized Residual Risk: 1 in 2,600
Fucosidosis	<i>FUCA1</i>	AR	Reduced Risk	Personalized Residual Risk: 1 in 9,200
Fumarase Deficiency	<i>FH</i>	AR	Reduced Risk	Personalized Residual Risk: 1 in 2,500
Fundus Albipunctatus	<i>RDH5</i>	AR	Reduced Risk	Personalized Residual Risk: 1 in 2,000
Galactokinase Deficiency	<i>GALK1</i>	AR	Reduced Risk	Personalized Residual Risk: 1 in 2,700
Galactose Epimerase Deficiency	<i>GALE</i>	AR	Reduced Risk	Personalized Residual Risk: 1 in 5,600
Galactosemia	<i>GALT</i>	AR	Reduced Risk	Personalized Residual Risk: 1 in 3,200
Galactosialidosis	<i>CTSA</i>	AR	Reduced Risk	Personalized Residual Risk: 1 in 7,900
Gaucher Disease	<i>GBA</i>	AR	Reduced Risk	Personalized Residual Risk: 1 in 1,300
Generalized Thyrotropin-Releasing Hormone Resistance	<i>TRHR</i>	AR	Reduced Risk	Personalized Residual Risk: 1 in 104,000
Geroderma Osteodysplasticum	<i>GORAB</i>	AR	Reduced Risk	Personalized Residual Risk: 1 in 70,000
Gitelman Syndrome	<i>SLC12A3</i>	AR	Reduced Risk	Personalized Residual Risk: 1 in 290
Glanzmann Thrombasthenia (ITGA2B-Related)	<i>ITGA2B</i>	AR	Reduced Risk	Personalized Residual Risk: 1 in 1,800
Glanzmann Thrombasthenia (ITGB3-Related)	<i>ITGB3</i>	AR	Reduced Risk	Personalized Residual Risk: 1 in 1,600
Glutaric Acidemia, Type I	<i>GCDH</i>	AR	Reduced Risk	Personalized Residual Risk: 1 in 2,700
Glutaric Acidemia, Type IIa	<i>ETFA</i>	AR	Reduced Risk	Personalized Residual Risk: 1 in 4,700
Glutaric Acidemia, Type IIb	<i>ETFB</i>	AR	Reduced Risk	Personalized Residual Risk: 1 in 5,900
Glutaric Acidemia, Type IIc	<i>ETFDH</i>	AR	Reduced Risk	Personalized Residual Risk: 1 in 1,700
Glutathione Synthetase Deficiency	<i>GSS</i>	AR	Reduced Risk	Personalized Residual Risk: 1 in 3,500
Glycine Encephalopathy (AMT-Related)	<i>AMT</i>	AR	Reduced Risk	Personalized Residual Risk: 1 in 5,700
Glycine Encephalopathy (GLDC-Related)	<i>GLDC</i>	AR	Reduced Risk	Personalized Residual Risk: 1 in 760
Glycogen Storage Disease, Type 0	<i>GYS2</i>	AR	Reduced Risk	Personalized Residual Risk: 1 in 1,200
Glycogen Storage Disease, Type Ia	<i>G6PC</i>	AR	Reduced Risk	Personalized Residual Risk: 1 in 5,300
Glycogen Storage Disease, Type Ib	<i>SLC37A4</i>	AR	Reduced Risk	Personalized Residual Risk: 1 in 7,300
Glycogen Storage Disease, Type II	<i>GAA</i>	AR	Reduced Risk	Personalized Residual Risk: 1 in 520
Glycogen Storage Disease, Type III	<i>AGL</i>	AR	Reduced Risk	Personalized Residual Risk: 1 in 5,600
Glycogen Storage Disease, Type IV / Adult Polyglucosan Body Disease	<i>GBE1</i>	AR	Reduced Risk	Personalized Residual Risk: 1 in 2,400
Glycogen Storage Disease, Type IXb	<i>PHKB</i>	AR	Reduced Risk	Personalized Residual Risk: 1 in 2,600



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
GRACILE Syndrome and Other <i>BCS1L</i> -Related Disorders	<i>BCS1L</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 3,900
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
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 Lyase Deficiency	<i>HMGCL</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 2,700
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
Hydroletharus 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 4 / Senior-Loken Syndrome 1 / Juvenile Nephronophthisis 1	<i>NPHP1</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 21,000
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: 1 in 25,000</b>
Junctional Epidermolysis Bullosa ( <i>ITGA6</i> -Related)	<i>ITGA6</i>	AR	Reduced Risk	<b>Personalized Residual Risk: 1 in 125,000</b>
Junctional Epidermolysis Bullosa ( <i>ITGB4</i> -Related)	<i>ITGB4</i>	AR	Reduced Risk	<b>Personalized Residual Risk: 1 in 2,400</b>
Junctional Epidermolysis Bullosa ( <i>LAMA3</i> -Related)	<i>LAMA3</i>	AR	Reduced Risk	<b>Personalized Residual Risk: 1 in 21,000</b>
Junctional Epidermolysis Bullosa ( <i>LAMB3</i> -Related)	<i>LAMB3</i>	AR	Reduced Risk	<b>Personalized Residual Risk: 1 in 1,900</b>
Junctional Epidermolysis Bullosa ( <i>LAMC2</i> -Related)	<i>LAMC2</i>	AR	Reduced Risk	<b>Personalized Residual Risk: 1 in 77,000</b>
Kohlschutter-Tonz Syndrome	<i>ROGDI</i>	AR	Reduced Risk	<b>Personalized Residual Risk: 1 in 2,300</b>
Krabbe Disease	<i>GALC</i>	AR	Reduced Risk	<b>Personalized Residual Risk: 1 in 860</b>
Lamellar Ichthyosis, Type 1	<i>TGM1</i>	AR	Reduced Risk	<b>Personalized Residual Risk: 1 in 1,500</b>
Laron Dwarfism	<i>GHR</i>	AR	Reduced Risk	<b>Personalized Residual Risk: 1 in 6,700</b>
Leber Congenital Amaurosis 10 and Other CEP290-Related Ciliopathies	<i>CEP290</i>	AR	Reduced Risk	<b>Personalized Residual Risk: 1 in 1,100</b>
Leber Congenital Amaurosis 13	<i>RDH12</i>	AR	Reduced Risk	<b>Personalized Residual Risk: 1 in 5,500</b>
Leber Congenital Amaurosis 15 / Retinitis Pigmentosa 14	<i>TULP1</i>	AR	Reduced Risk	<b>Personalized Residual Risk: 1 in 2,800</b>
Leber Congenital Amaurosis 2 / Retinitis Pigmentosa 20	<i>RPE65</i>	AR	Reduced Risk	<b>Personalized Residual Risk: 1 in 2,500</b>
Leber Congenital Amaurosis 4	<i>AIP1</i>	AR	Reduced Risk	<b>Personalized Residual Risk: 1 in 2,100</b>
Leber Congenital Amaurosis 5	<i>LCA5</i>	AR	Reduced Risk	<b>Personalized Residual Risk: 1 in 14,000</b>
Leber Congenital Amaurosis 8 / Retinitis Pigmentosa 12 / Pigmented Paravenous Chorioretinal Atrophy	<i>CRB1</i>	AR	Reduced Risk	<b>Personalized Residual Risk: 1 in 990</b>
Leigh Syndrome ( <i>NDUFS7</i> -Related)	<i>NDUFS7</i>	AR	Reduced Risk	<b>Personalized Residual Risk: 1 in 26,000</b>
Leigh Syndrome ( <i>SURF1</i> -Related)	<i>SURF1</i>	AR	Reduced Risk	<b>Personalized Residual Risk: 1 in 4,400</b>
Leigh Syndrome, French-Canadian Type	<i>LRPPRC</i>	AR	Reduced Risk	<b>Personalized Residual Risk: 1 in 32,000</b>
Lethal Congenital Contracture Syndrome 1 / Lethal Arthrogyposis with Anterior Horn Cell Disease	<i>GLE1</i>	AR	Reduced Risk	<b>Personalized Residual Risk: 1 in 10,000</b>
Lethal Congenital Contracture Syndrome 2	<i>ERBB3</i>	AR	Reduced Risk	<b>Personalized Residual Risk: 1 in 96,000</b>
Lethal Congenital Contracture Syndrome 3	<i>PIP5K1C</i>	AR	Reduced Risk	<b>Personalized Residual Risk: 1 in 318,000</b>
Leukoencephalopathy with Vanishing White Matter	<i>EIF2B5</i>	AR	Reduced Risk	<b>Personalized Residual Risk: 1 in 2,300</b>
Limb-Girdle Muscular Dystrophy, Type 2A	<i>CAPN3</i>	AR	Reduced Risk	<b>Personalized Residual Risk: 1 in 960</b>
Limb-Girdle Muscular Dystrophy, Type 2B	<i>DYSF</i>	AR	Reduced Risk	<b>Personalized Residual Risk: 1 in 1,100</b>
Limb-Girdle Muscular Dystrophy, Type 2C	<i>SGCG</i>	AR	Reduced Risk	<b>Personalized Residual Risk: 1 in 4,900</b>
Limb-Girdle Muscular Dystrophy, Type 2D	<i>SGCA</i>	AR	Reduced Risk	<b>Personalized Residual Risk: 1 in 3,500</b>
Limb-Girdle Muscular Dystrophy, Type 2E	<i>SGCB</i>	AR	Reduced Risk	<b>Personalized Residual Risk: 1 in 31,000</b>
Limb-Girdle Muscular Dystrophy, Type 2F	<i>SGCD</i>	AR	Reduced Risk	<b>Personalized Residual Risk: 1 in 52,000</b>
Limb-Girdle Muscular Dystrophy, Type 2H	<i>TRIM32</i>	AR	Reduced Risk	<b>Personalized Residual Risk: 1 in 10,000</b>
Limb-Girdle Muscular Dystrophy, Type 2I	<i>FKRP</i>	AR	Reduced Risk	<b>Personalized Residual Risk: 1 in 1,400</b>
Limb-Girdle Muscular Dystrophy, Type 2L	<i>ANO5</i>	AR	Reduced Risk	<b>Personalized Residual Risk: 1 in 660</b>
Lipoamide Dehydrogenase Deficiency	<i>DLD</i>	AR	Reduced Risk	<b>Personalized Residual Risk: 1 in 14,000</b>
Lipoid Adrenal Hyperplasia	<i>STAR</i>	AR	Reduced Risk	<b>Personalized Residual Risk: 1 in 3,600</b>
Lipoprotein Lipase Deficiency	<i>LPL</i>	AR	Reduced Risk	<b>Personalized Residual Risk: 1 in 2,400</b>
Long-Chain 3-Hydroxyacyl-CoA Dehydrogenase Deficiency	<i>HADHA</i>	AR	Reduced Risk	<b>Personalized Residual Risk: 1 in 5,900</b>
Lowe Syndrome	<i>OCRL</i>	XL	Reduced Risk	<b>Personalized Residual Risk: 1 in 1,375,000</b>
Lysinuric Protein Intolerance	<i>SLC7A7</i>	AR	Reduced Risk	<b>Personalized Residual Risk: 1 in 3,000</b>
Malonyl-CoA Decarboxylase Deficiency	<i>MLYCD</i>	AR	Reduced Risk	<b>Personalized Residual Risk: 1 in 2,800</b>
Maple Syrup Urine Disease, Type 1a	<i>BCKDHA</i>	AR	Reduced Risk	<b>Personalized Residual Risk: 1 in 5,100</b>
Maple Syrup Urine Disease, Type 1b	<i>BCKDHB</i>	AR	Reduced Risk	<b>Personalized Residual Risk: 1 in 1,100</b>

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
MEDNIK Syndrome	<i>AP1S1</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 211,000
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>MAT1A</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

<b>Molybdenum Cofactor Deficiency A</b>	<i>MOCS1</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 4,700
<b>Mucopolipidosis II / IIIA</b>	<i>GNPTAB</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 2,100
<b>Mucopolipidosis III Gamma</b>	<i>GNPTG</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 68,000
<b>Mucopolipidosis IV</b>	<i>MCOLN1</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 9,400
<b>Mucopolysaccharidosis Type I</b>	<i>IDUA</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 3,300
<b>Mucopolysaccharidosis Type II</b>	<i>IDS</i>	XL	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 76,000
<b>Mucopolysaccharidosis Type IIIA</b>	<i>SGSH</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 2,700
<b>Mucopolysaccharidosis Type IIIB</b>	<i>NAGLU</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 950
<b>Mucopolysaccharidosis Type IIIC</b>	<i>HGSNAT</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 3,200
<b>Mucopolysaccharidosis Type IIID</b>	<i>GNS</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 137,000
<b>Mucopolysaccharidosis Type IVa</b>	<i>GALNS</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 690
<b>Mucopolysaccharidosis Type IVb / GM1 Gangliosidosis</b>	<i>GLB1</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 1,700
<b>Mucopolysaccharidosis type IX</b>	<i>HYAL1</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 149,000
<b>Mucopolysaccharidosis type VI</b>	<i>ARSB</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 1,300
<b>Mucopolysaccharidosis VII</b>	<i>GUSB</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 1,600
<b>Mulibrey Nanism</b>	<i>TRIM37</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 31,000
<b>Multiple Congenital Anomalies-Hypotonia-Seizures Syndrome 1</b>	<i>PIGN</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 2,800
<b>Multiple Pterygium Syndrome</b>	<i>CHRNA3</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 9,900
<b>Multiple Sulfatase Deficiency</b>	<i>SUMF1</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 69,000
<b>Muscle-Eye-Brain Disease and Other <i>POMGNT1</i>-Related Congenital Muscular Dystrophy-Dystroglycanopathies</b>	<i>POMGNT1</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 4,200
<b>Myoneurogastrointestinal Encephalopathy</b>	<i>TYMP</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 2,100
<b>Myotubular Myopathy 1</b>	<i>MTM1</i>	XL	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 192,000
<b>N-Acetylglutamate Synthase Deficiency</b>	<i>NAGS</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 3,200
<b>Nemaline Myopathy 2</b>	<i>NEB</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 2,400
<b>Nephrogenic Diabetes insipidus (<i>AVPR2</i>-related) / Nephrogenic Syndrome of Inappropriate Antidiuresis</b>	<i>AVPR2</i>	XL	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 471,000
<b>Nephrogenic Diabetes Insipidus, Type II</b>	<i>AQP2</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 3,400
<b>Nephronophthisis 2</b>	<i>INVS</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 56,000
<b>Nephrotic Syndrome (<i>NPHS1</i>-Related) / Congenital Finnish Nephrosis</b>	<i>NPHS1</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 920
<b>Nephrotic Syndrome (<i>NPHS2</i>-Related) / Steroid-Resistant Nephrotic Syndrome</b>	<i>NPHS2</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 780
<b>Neurodegeneration due to Cerebral Folate Transport Deficiency</b>	<i>FOLR1</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 5,300
<b>Neurodevelopmental Disorder with Progressive Microcephaly, Spasticity, and Brain Anomalies</b>	<i>PLAA</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 229,000
<b>Neuronal Ceroid-Lipofuscinosis (<i>CLN3</i>-Related)</b>	<i>CLN3</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 9,200
<b>Neuronal Ceroid-Lipofuscinosis (<i>CLN5</i>-Related)</b>	<i>CLN5</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 4,300
<b>Neuronal Ceroid-Lipofuscinosis (<i>CLN6</i>-Related)</b>	<i>CLN6</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 8,600
<b>Neuronal Ceroid-Lipofuscinosis (<i>CLN8</i>-Related)</b>	<i>CLN8</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 3,100
<b>Neuronal Ceroid-Lipofuscinosis (<i>MFSD8</i>-Related)</b>	<i>MFSD8</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 6,200
<b>Neuronal Ceroid-Lipofuscinosis (<i>PPT1</i>-Related)</b>	<i>PPT1</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 7,500
<b>Neuronal Ceroid-Lipofuscinosis (<i>TPP1</i>-Related)</b>	<i>TPP1</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 6,300
<b>Niemann-Pick Disease (<i>SMPD1</i>-Related)</b>	<i>SMPD1</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 1,800
<b>Niemann-Pick Disease, Type C (<i>NPC1</i>-Related)</b>	<i>NPC1</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 690
<b>Niemann-Pick Disease, Type C (<i>NPC2</i>-Related)</b>	<i>NPC2</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 6,600
<b>Nijmegen Breakage Syndrome</b>	<i>NBN</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 14,000
<b>Non-Syndromic Hearing Loss (<i>GJB2</i>-Related)</b>	<i>GJB2</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 600
<b>Oculocutaneous Albinism, Type IA / IB</b>	<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: 1 in 830</b>
Odonto-Onycho-Dermal Dysplasia / Schopf-Schulz-Passarge Syndrome	<i>WNT10A</i>	AR	Reduced Risk	<b>Personalized Residual Risk: 1 in 1,900</b>
Omenn Syndrome ( <i>RAG2</i> -Related)	<i>RAG2</i>	AR	Reduced Risk	<b>Personalized Residual Risk: 1 in 17,000</b>
Omenn Syndrome / Severe Combined Immunodeficiency, Athabaskan-Type	<i>DCLRE1C</i>	AR	Reduced Risk	<b>Personalized Residual Risk: 1 in 5,500</b>
Omenn Syndrome and other <i>RAG1</i> -Related Disorders	<i>RAG1</i>	AR	Reduced Risk	<b>Personalized Residual Risk: 1 in 850</b>
Ornithine Aminotransferase Deficiency	<i>OAT</i>	AR	Reduced Risk	<b>Personalized Residual Risk: 1 in 6,400</b>
Ornithine Transcarbamylase Deficiency	<i>OTC</i>	XL	Reduced Risk	<b>Personalized Residual Risk: 1 in 103,000</b>
Osteogenesis Imperfecta, Type XI	<i>FKBP10</i>	AR	Reduced Risk	<b>Personalized Residual Risk: 1 in 9,500</b>
Osteopetrosis 1	<i>TCIRG1</i>	AR	Reduced Risk	<b>Personalized Residual Risk: 1 in 4,700</b>
Osteopetrosis 8	<i>SNX10</i>	AR	Reduced Risk	<b>Personalized Residual Risk: 1 in 16,000</b>
Otospondylomegaepiphyseal Dysplasia / Deafness / Fibrochondrogenesis 2	<i>COL11A2</i>	AR	Reduced Risk	<b>Personalized Residual Risk: 1 in 2,700</b>
Papillon-Lefevre Syndrome	<i>CTSC</i>	AR	Reduced Risk	<b>Personalized Residual Risk: 1 in 5,000</b>
Pendred Syndrome	<i>SLC26A4</i>	AR	Reduced Risk	<b>Personalized Residual Risk: 1 in 390</b>
Peroxisome Biogenesis Disorder 3A and 3B	<i>PEX12</i>	AR	Reduced Risk	<b>Personalized Residual Risk: 1 in 30,000</b>
Peroxisome Biogenesis Disorder 7A and 7B	<i>PEX26</i>	AR	Reduced Risk	<b>Personalized Residual Risk: 1 in 70,000</b>
Phenylalanine Hydroxylase Deficiency	<i>PAH</i>	AR	Reduced Risk	<b>Personalized Residual Risk: 1 in 340</b>
Polycystic Kidney Disease, Autosomal Recessive	<i>PKHD1</i>	AR	Reduced Risk	<b>Personalized Residual Risk: 1 in 450</b>
Polyglandular Autoimmune Syndrome, Type 1	<i>AIRE</i>	AR	Reduced Risk	<b>Personalized Residual Risk: 1 in 5,300</b>
Pontocerebellar Hypoplasia, Type 1A	<i>VRK1</i>	AR	Reduced Risk	<b>Personalized Residual Risk: 1 in 25,000</b>
Pontocerebellar Hypoplasia, Type 1B	<i>EXOSC3</i>	AR	Reduced Risk	<b>Personalized Residual Risk: 1 in 10,000</b>
Pontocerebellar Hypoplasia, Type 2A and Type 4	<i>TSEN54</i>	AR	Reduced Risk	<b>Personalized Residual Risk: 1 in 4,700</b>
Pontocerebellar Hypoplasia, Type 2E	<i>VPS53</i>	AR	Reduced Risk	<b>Personalized Residual Risk: 1 in 139,000</b>
Pontocerebellar Hypoplasia, Type 6	<i>RARS2</i>	AR	Reduced Risk	<b>Personalized Residual Risk: 1 in 8,600</b>
Primary Carnitine Deficiency	<i>SLC22A5</i>	AR	Reduced Risk	<b>Personalized Residual Risk: 1 in 1,500</b>
Primary Ciliary Dyskinesia ( <i>CCDC103</i> -Related)	<i>CCDC103</i>	AR	Reduced Risk	<b>Personalized Residual Risk: 1 in 27,000</b>
Primary Ciliary Dyskinesia ( <i>CCDC151</i> -Related)	<i>CCDC151</i>	AR	Reduced Risk	<b>Personalized Residual Risk: 1 in 59,000</b>
Primary Ciliary Dyskinesia ( <i>CCDC39</i> -Related)	<i>CCDC39</i>	AR	Reduced Risk	<b>Personalized Residual Risk: 1 in 12,000</b>
Primary Ciliary Dyskinesia ( <i>DNAH5</i> -Related)	<i>DNAH5</i>	AR	Reduced Risk	<b>Personalized Residual Risk: 1 in 1,500</b>
Primary Ciliary Dyskinesia ( <i>DNAI1</i> -Related)	<i>DNAI1</i>	AR	Reduced Risk	<b>Personalized Residual Risk: 1 in 5,000</b>
Primary Ciliary Dyskinesia ( <i>DNAI2</i> -Related)	<i>DNAI2</i>	AR	Reduced Risk	<b>Personalized Residual Risk: 1 in 76,000</b>
Primary Ciliary Dyskinesia ( <i>RSPH9</i> -Related)	<i>RSPH9</i>	AR	Reduced Risk	<b>Personalized Residual Risk: 1 in 253,000</b>
Primary Coenzyme Q10 Deficiency 7	<i>COQ4</i>	AR	Reduced Risk	<b>Personalized Residual Risk: 1 in 12,000</b>
Primary Congenital Glaucoma 3A	<i>CYP11B1</i>	AR	Reduced Risk	<b>Personalized Residual Risk: 1 in 880</b>
Primary Hyperoxaluria, Type 1	<i>AGXT</i>	AR	Reduced Risk	<b>Personalized Residual Risk: 1 in 1,900</b>
Primary Hyperoxaluria, Type 2	<i>GRHPR</i>	AR	Reduced Risk	<b>Personalized Residual Risk: 1 in 11,000</b>
Primary Hyperoxaluria, Type 3	<i>HOGA1</i>	AR	Reduced Risk	<b>Personalized Residual Risk: 1 in 2,400</b>
Progressive Cerebello-Cerebral Atrophy	<i>SEPSECS</i>	AR	Reduced Risk	<b>Personalized Residual Risk: 1 in 6,400</b>
Progressive Familial Intrahepatic Cholestasis, Type 2	<i>ABCB11</i>	AR	Reduced Risk	<b>Personalized Residual Risk: 1 in 950</b>
Progressive Myoclonic Epilepsy, Type 1B	<i>PRICKLE1</i>	AR	Reduced Risk	<b>Personalized Residual Risk: 1 in 98,000</b>
Progressive Pseudorheumatoid Dysplasia	<i>WISP3</i>	AR	Reduced Risk	<b>Personalized Residual Risk: 1 in 5,600</b>
Prolidase Deficiency	<i>PEPD</i>	AR	Reduced Risk	<b>Personalized Residual Risk: 1 in 30,000</b>
Propionic Acidemia ( <i>PCCA</i> -Related)	<i>PCCA</i>	AR	Reduced Risk	<b>Personalized Residual Risk: 1 in 2,600</b>
Propionic Acidemia ( <i>PCCB</i> -Related)	<i>PCCB</i>	AR	Reduced Risk	<b>Personalized Residual Risk: 1 in 12,000</b>
Pulmonary Surfactant Dysfunction	<i>ABCA3</i>	AR	Reduced Risk	<b>Personalized Residual Risk: 1 in 1,200</b>
Pycnodysostosis	<i>CTSK</i>	AR	Reduced Risk	<b>Personalized Residual Risk: 1 in 5,100</b>
Pyridoxamine 5'-Phosphate Oxidase Deficiency	<i>PNPO</i>	AR	Reduced Risk	<b>Personalized Residual Risk: 1 in 10,000</b>



Pyridoxine-Dependent Epilepsy	<i>ALDH7A1</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 1,100
Pyruvate Carboxylase Deficiency	<i>PC</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 8,000
Pyruvate Dehydrogenase E1-Alpha Deficiency	<i>PDHA1</i>	XL	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 139,000
Pyruvate Dehydrogenase E1-Beta Deficiency	<i>PDHB</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 15,000
Renal Tubular Acidosis and Deafness	<i>ATP6V1B1</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 6,600
Retinitis Pigmentosa 25	<i>EYS</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 1,800
Retinitis Pigmentosa 26	<i>CERKL</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 13,000
Retinitis Pigmentosa 28	<i>FAM161A</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 34,000
Retinitis Pigmentosa 36	<i>PRCD</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 304,000
Retinitis Pigmentosa 59	<i>DHDDS</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 601,000
Retinitis Pigmentosa 64 / Bardet-Biedl Syndrome 21 / Cone-Rod Dystrophy 16	<i>C8ORF37</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 168,000
Rh Deficiency Syndrome	<i>RHAG</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 46,000
Rhizomelic Chondrodysplasia Punctata, Type 1	<i>PEX7</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 10,000
Rhizomelic Chondrodysplasia Punctata, Type 3	<i>AGPS</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 620,000
Roberts Syndrome	<i>ESCO2</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 139,000
Salla Disease	<i>SLC17A5</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 8,400
Salt and Pepper Developmental Regression Syndrome	<i>ST3GAL5</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 25,000
Sandhoff Disease	<i>HEXB</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 1,800
Schimke Immunoosseous Dysplasia	<i>SMARCA1</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 3,800
Seckel Syndrome 5 / Microcephaly 9	<i>CEP152</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 1,700
Segawa Syndrome	<i>TH</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 6,100
Sepiapterin Reductase Deficiency	<i>SPR</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 35,000
Severe Combined Immunodeficiency ( <i>IL7R</i> -Related)	<i>IL7R</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 20,000
Severe Combined Immunodeficiency ( <i>JAK3</i> -Related)	<i>JAK3</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 2,100
Severe Combined Immunodeficiency ( <i>PTPRC</i> -Related)	<i>PTPRC</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 8,500
Severe Congenital Neutropenia 4	<i>G6PC3</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 10,000
Severe Neonatal Hyperparathyroidism	<i>CASR</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 2,700
Short Stature, Onychodysplasia, Facial Dysmorphism, and Hypotrichosis	<i>POC1A</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 108,000
Short-Chain Acyl-CoA Dehydrogenase Deficiency	<i>ACADS</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 660
Shwachman-Diamond Syndrome	<i>SBDS</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 1,700
Sialidosis, Type I and Type II	<i>NEU1</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 2,000
Sjogren-Larsson Syndrome	<i>ALDH3A2</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 5,500
Smith-Lemli-Opitz Syndrome	<i>DHCR7</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 750
Spastic Paraplegia 15	<i>ZFYVE26</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 46,000
Spastic Tetraplegia, Thin Corpus Callosum, and Progressive Microcephaly	<i>SLC1A4</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 855,000
Spherocytosis, Type 5	<i>EPB42</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 3,200
Spinal Muscular Atrophy	<i>SMN1</i>	AR	Reduced Risk	SMN1 copy number: 2 SMN2 copy number: 2 c.380T>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	<i>IGHMBP2</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 1,200
Spinocerebellar Ataxia with Axonal Neuropathy 3	<i>COA7</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 12,000
Spondylocostal Dysostosis 1	<i>DLL3</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 7,200
Spondylometaphyseal Dysplasia ( <i>DDR2</i> -Related)	<i>DDR2</i>	AR	Reduced Risk	<b>Personalized Residual Risk:</b> 1 in 236,000

Spondylothoracic Dysostosis	MESP2	AR	Reduced Risk	Personalized Residual Risk: 1 in 382,000
Steel Syndrome	COL27A1	AR	Reduced Risk	Personalized Residual Risk: 1 in 93,000
Stuve-Wiedemann Syndrome	LIFR	AR	Reduced Risk	Personalized Residual Risk: 1 in 6,000
Sulfate Transporter-Related Osteochondrodysplasia	SLC26A2	AR	Reduced Risk	Personalized Residual Risk: 1 in 1,800
Tay-Sachs Disease	HEXA	AR	Reduced Risk	Personalized Residual Risk: 1 in 1,400
Thiamine-Responsive Megaloblastic Anemia Syndrome	SLC19A2	AR	Reduced Risk	Personalized Residual Risk: 1 in 11,000
Thyroid Dysmorphogenesis 1	SLC5A5	AR	Reduced Risk	Personalized Residual Risk: 1 in 45,000
Thyroid Dysmorphogenesis 2A	TPO	AR	Reduced Risk	Personalized Residual Risk: 1 in 910
Thyroid Dysmorphogenesis 3	TG	AR	Reduced Risk	Personalized Residual Risk: 1 in 850
Thyroid Dysmorphogenesis 4	IYD	AR	Reduced Risk	Personalized Residual Risk: 1 in 1,800
Thyroid Dysmorphogenesis 5	DUOXA2	AR	Reduced Risk	Personalized Residual Risk: 1 in 29,000
Thyroid Dysmorphogenesis 6	DUOX2	AR	Reduced Risk	Personalized Residual Risk: 1 in 190
Trichohepatoenteric Syndrome 1	TTC37	AR	Reduced Risk	Personalized Residual Risk: 1 in 14,000
Tyrosinemia, Type I	FAH	AR	Reduced Risk	Personalized Residual Risk: 1 in 1,900
Tyrosinemia, Type II	TAT	AR	Reduced Risk	Personalized Residual Risk: 1 in 4,800
Tyrosinemia, Type III	HPD	AR	Reduced Risk	Personalized Residual Risk: 1 in 266,000
Usher Syndrome, Type IB	MYO7A	AR	Reduced Risk	Personalized Residual Risk: 1 in 1,000
Usher Syndrome, Type IC	USH1C	AR	Reduced Risk	Personalized Residual Risk: 1 in 1,600
Usher Syndrome, Type ID	CDH23	AR	Reduced Risk	Personalized Residual Risk: 1 in 1,400
Usher Syndrome, Type IF	PCDH15	AR	Reduced Risk	Personalized Residual Risk: 1 in 3,800
Usher Syndrome, Type IIA	USH2A	AR	Reduced Risk	Personalized Residual Risk: 1 in 290
Usher Syndrome, Type III	CLRN1	AR	Reduced Risk	Personalized Residual Risk: 1 in 1,300
Very Long Chain Acyl-CoA Dehydrogenase Deficiency	ACADVL	AR	Reduced Risk	Personalized Residual Risk: 1 in 920
Vitamin D-Dependent Rickets, Type I	CYP27B1	AR	Reduced Risk	Personalized Residual Risk: 1 in 7,900
Vitamin D-Resistant Rickets, Type IIA	VDR	AR	Reduced Risk	Personalized Residual Risk: 1 in 17,000
Walker-Warburg Syndrome and Other FKTN-Related Dystrophies	FKTN	AR	Reduced Risk	Personalized Residual Risk: 1 in 4,200
Werner Syndrome	WRN	AR	Reduced Risk	Personalized Residual Risk: 1 in 9,200
Wilson Disease	ATP7B	AR	Reduced Risk	Personalized Residual Risk: 1 in 350
Wiskott-Aldrich Syndrome (WAS-Related)	WAS	XL	Reduced Risk	Personalized Residual Risk: 1 in 1,203,000
Wolcott-Rallison Syndrome	EIF2AK3	AR	Reduced Risk	Personalized Residual Risk: 1 in 22,000
Wolman Disease / Cholesteryl Ester Storage Disease	LIPA	AR	Reduced Risk	Personalized Residual Risk: 1 in 3,200
Woodhouse-Sakati Syndrome	DCAF17	AR	Reduced Risk	Personalized Residual Risk: 1 in 81,000
X-Linked Juvenile Retinoschisis	RS1	XL	Reduced Risk	Personalized Residual Risk: 1 in 40,000
X-Linked Severe Combined Immunodeficiency	IL2RG	XL	Reduced Risk	Personalized Residual Risk: 1 in 250,000
Xeroderma Pigmentosum (POLH-Related)	POLH	AR	Reduced Risk	Personalized Residual Risk: 1 in 5,900
Xeroderma Pigmentosum, Group A	XPA	AR	Reduced Risk	Personalized Residual Risk: 1 in 11,000
Xeroderma Pigmentosum, Group C	XPC	AR	Reduced Risk	Personalized Residual Risk: 1 in 12,000
Xeroderma Pigmentosum, Group G	ERCC5	AR	Reduced Risk	Personalized Residual Risk: 1 in 3,000
Zellweger Syndrome Spectrum (PEX10-Related)	PEX10	AR	Reduced Risk	Personalized Residual Risk: 1 in 6,300
Zellweger Syndrome Spectrum (PEX1-Related)	PEX1	AR	Reduced Risk	Personalized Residual Risk: 1 in 2,000
Zellweger Syndrome Spectrum (PEX2-Related)	PEX2	AR	Reduced Risk	Personalized Residual Risk: 1 in 77,000
Zellweger Syndrome Spectrum (PEX6-Related)	PEX6	AR	Reduced Risk	Personalized Residual Risk: 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>™</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; *DNAL2* (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; *F5* (NM\_000130.4) chr1:169,551,662-169,551,679 (partial exon 2); *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%)

The 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.

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.

## SELECTED REFERENCES

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Luo M et al. An Ashkenazi Jewish SMN1 haplotype specific to duplication alleles improves pan-ethnic carrier screening for spinal muscular atrophy. *Genet Med*. 2014 16:149-56.

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Scott SA et al. Experience with carrier screening and prenatal diagnosis for sixteen Ashkenazi Jewish Genetic Diseases. *Hum. Mutat.* 2010 31:1-11.

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Richards S et al. Standards and guidelines for the interpretation of sequence variants: a joint consensus recommendation of the American College of Medical Genetics and Genomics and the Association for Molecular Pathology. *Genet Med*. 2015 May;17(5):405-24

Additional disease-specific references available upon request.



Patient Information	Specimen Information	Client Information
<b>6481, DONOR</b>  <b>DOB:</b> [REDACTED] <b>AGE:</b> [REDACTED] Gender: M Phone: NG Patient ID: [REDACTED]	Specimen: [REDACTED] Requisition: [REDACTED] Lab Ref #: [REDACTED]  Collected: 07/25/2022 Received: 07/26/2022 / 20:39 EDT Reported: 08/02/2022 / 20:59 EDT	Client #: 48041578     NYNJMAIL GENOMICS, SEMA4 SEMA4 62 SOUTHFIELD AVE STAMFORD, CT 06902-7229

Ward:     FFXCB
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**Cytogenetic Report**

**CHROMOSOME ANALYSIS, BLOOD - 14596** **Lab:EZ**

**CHROMOSOME ANALYSIS, BLOOD**

Order ID: [REDACTED]  
 Specimen Type: Blood  
 Clinical Indication: RULE OUT CHROMOSOME ABNORMALITY

**RESULT:**  
 NORMAL MALE KARYOTYPE

**INTERPRETATION:**  
 Chromosome analysis revealed normal G-band patterns within the limits of standard cytogenetic analysis.

Please expect the results of any other concurrent study in a separate report.

**NOMENCLATURE:**  
 46,XY

**ASSAY INFORMATION:**

Method: G-Band (Digital Analysis: MetaSyst)  
 Cells Counted: 20  
 Band Level: 450  
 Cells Analyzed: 5  
 Cells Karyotyped: 4

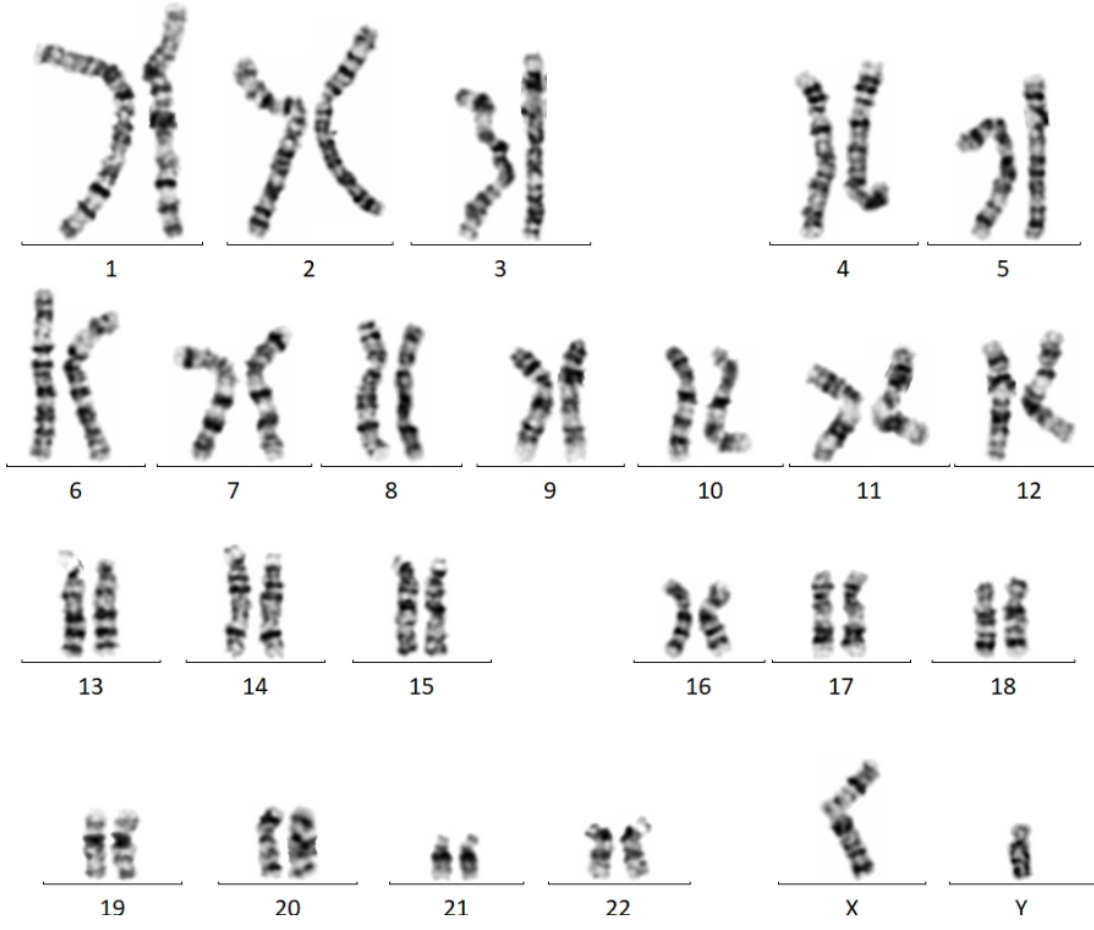
This test does not address genetic disorders that cannot be detected by standard cytogenetic methods or rare events such as low level mosaicism or subtle rearrangements.

Guang Li, PhD, FACMG

Electronic Signature:     8/2/2022 7:19 PM



Patient Information	Specimen Information	Client Information
<b>6481, DONOR</b>  <b>DOB:</b> [REDACTED] <b>AGE:</b> [REDACTED] Gender: M Patient ID: [REDACTED]	Specimen: [REDACTED] Collected: 07/25/2022 Received: 07/26/2022 / 20:39 EDT Reported: 08/02/2022 / 20:59 EDT	Client #: 48041578 GENOMICS, SEMA4



**PERFORMING SITE:**

EZ QUEST DIAGNOSTICS/NICHOLS SJ, 33608 ORTEGA HWY, SAN JUAN CAPISTRANO, CA 92675-2042 Laboratory Director: IRINA MARAMICA,MD,PHD,MBA, CLIA: 05D0643352



Patient Information	Specimen Information	Client Information
<b>6481, DONOR</b>  <b>DOB:</b> [REDACTED] <b>AGE:</b> [REDACTED] Gender: M Phone: NG Patient ID: [REDACTED]	Specimen: [REDACTED] Requisition: [REDACTED] Lab Ref #: [REDACTED]  Collected: 07/25/2022 Received: 07/26/2022 / 20:39 EDT Reported: 07/27/2022 / 15:38 EDT	Client #: 48041578    NYNJMAIL GENOMICS, SEMA4 SEMA4 62 SOUTHFIELD AVE STAMFORD, CT 06902-7229

Ward:        FFXCB

Test Name	In Range	Out Of Range	Reference Range	Lab
HEMOGLOBINOPATHY EVALUATION				
RED BLOOD CELL COUNT	4.75		4.20-5.80 Million/uL	Z99
HEMOGLOBIN	14.3		13.2-17.1 g/dL	
HEMATOCRIT	44.9		38.5-50.0 %	
MCV	94.5		80.0-100.0 fL	
MCH	30.1		27.0-33.0 pg	
RDW	13.1		11.0-15.0 %	
HEMOGLOBIN A	97.1		>96.0 %	Z99
HEMOGLOBIN F	<1.0		<2.0 %	
HEMOGLOBIN A2 (QUANT)	2.9		2.2-3.2 %	
INTERPRETATION	*			
Normal phenotype.				

**PERFORMING SITE:**

Z99    QUEST DIAGNOSTICS CLIFTON, 1 INSIGHTS DRIVE, CLIFTON, NJ 07012-2355 Laboratory Director: SHELLA K MONGIA,MD, CLIA: 31D0696246