



Donor 4713

Genetic Testing Summary

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

Last Updated: 03/27/20

Donor Reported Ancestry: Russian, English

Jewish Ancestry: Yes

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
Cystic Fibrosis (CF) carrier screening	Negative by genotyping of 99 mutations in the CFTR gene	1/300
Spinal Muscular Atrophy (SMA) carrier screening	Negative for deletions of exon 7 in the SMN1 gene	1/610
Hb Beta Chain-Related Hemoglobinopathy (including Beta Thalassemia and Sickle Cell Disease) by genotyping	Negative for 28 mutations tested in the HBB gene	1/290
ABCC8-related Hyperinsulinism	Negative for 3 mutations tested in the ABCC8 gene	1/110
Bloom Syndrome	Negative for 1 mutation tested in the BLM gene	<1/500
Canavan Disease	Negative for 4 mutations tested in the ASPA gene	<1/500

Familial Dysautonomia	Negative for 2 mutations tested in the IKBKAP gene	<1/500
Fanconi Anemia Type C	Negative for 3 mutations tested in the FANCC gene	1/340
Gaucher Disease	Negative for 10 mutations tested in the GBA gene	1/280
Glycogen Storage Disease 1 A	Negative for 7 mutations tested in the G6PC gene	1/450
Hexosaminidase A Deficiency (including Tay Sachs Disease)	Negative for 9 mutations tested in the HEXA gene	1/390
Lipoamide Dehydrogenase Deficiency	Negative for 2 mutations tested in the DLD gene	<1/500
Maple Syrup Urine Disease Type 1 B	Negative for 3 mutations tested in the BCKDHB gene	1/250
Mucopolipidosis IV	Negative for 2 mutations tested in the MCOLN1 gene	<1/500
Niemann-Pick Disease, SMPD1-associated	Negative for 4 mutations tested in the SMPD1 gene	1/400
Usher Syndrome Type 1 F	Negative for 1 mutation tested in the PCDH15 gene	1/190
Usher Syndrome Type 3	Negative for 1 mutation tested in the CLRN1 gene	<1/500
Tay Sachs enzyme analysis	Non-carrier by Hexosaminidase A activity	
Special Testing		
Homocystinuria (CBS-Related)	Negative by gene sequencing in the CBS gene	1/1400

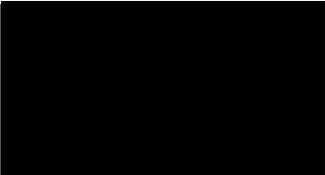
*No single test can screen for all genetic disorders. A negative screening result significantly reduces, but cannot eliminate, the risk for these conditions in a pregnancy.

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



Results Recipient

Fairfax Cryobank - [REDACTED]



Report Date: 09/12/2013

Male

Name: DONOR 4713
DOB: [REDACTED]
Ethnicity: Mixed or Other
Caucasian
Sample Type: OG-510 Saliva
Date of Collection: 09/05/2013
Date Received: 09/09/2013
Barcode: [REDACTED]
Indication: Egg or Sperm Donor
Test Type: The Counsyl Test

Female

Not tested

Counsyl Test Results Summary (Egg or Sperm Donor)

The Counsyl test (**Fairfax Cryobank Jewish Panel**) uses targeted genotyping and copy number analysis as described in the methods section on page 2 to determine carrier status associated with **17 diseases**. Please refer to page 3 for a complete list of diseases and genes included in this panel.



DONOR 4713



DONOR 4713's DNA test shows that he is not a carrier of any disease-causing mutation tested.



Partner

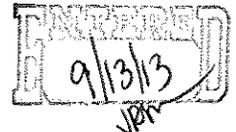
The reproductive risk presented is based on a hypothetical pairing with a partner of the same ethnic group.

Reproductive Risk Summary

No increased reproductive risks to highlight. Please refer to the following pages for detailed information about the results.

Clinical Notes

- If necessary, patients can discuss residual risks with their physician or a genetic counselor. To schedule a complimentary appointment to speak with a genetic counselor about these results, please visit counsyl.com/counseling/.





Male
Name: DONOR 4713
DOB: [REDACTED]

Female
Not tested

Methods and Limitations

DONOR 4713: The Counsyl Test - targeted genotyping and copy number analysis.

Targeted genotyping: Targeted DNA mutation analysis is used to simultaneously determine the genotype of 179 variants associated with 16 diseases. The test is not validated for detection of homozygous mutations, and although rare, asymptomatic individuals affected by the disease may not be genotyped accurately.

Copy number analysis: Targeted copy number analysis is used to determine the copy number of exon 7 of the SMN1 gene relative to other genes. Other mutations may interfere with this analysis. Some individuals with two copies of SMN1 are carriers with two SMN1 genes on one chromosome and a SMN1 deletion on the other chromosome. In addition, a small percentage of SMA cases are caused by nondeletion mutations in the SMN1 gene. Thus, a test result of two SMN1 copies significantly reduces the risk of being a carrier; however, there is still a residual risk of being a carrier and subsequently a small risk of future affected offspring for individuals with two or more SMN1 gene copies. Some SMA cases arise as the result of de novo mutation events which will not be detected by carrier testing.

Limitations: In an unknown number of cases, nearby genetic variants may interfere with mutation detection. Other possible sources of diagnostic error include sample mix-up, trace contamination, bone marrow transplantation, blood transfusions and technical errors. The Counsyl test does not fully address all inherited forms of intellectual disability, birth defects and genetic disease. A family history of any of these conditions may warrant additional evaluation. Furthermore, not all mutations will be identified in the genes analyzed and additional testing may be beneficial for some patients. For example, individuals of African, Southeast Asian, and Mediterranean ancestry are at increased risk for being carriers for hemoglobinopathies, which can be identified by CBC and hemoglobin electrophoresis or HPLC (*ACOG Practice Bulletin No. 78. Obstet. Gynecol. 2007;109:229-37*) and additional Tay-Sachs disease testing can be performed using a biochemical assay (*Gross et al. Genet. Med. 2008;10(1):54-56*).

This test was developed and its performance characteristics determined by Counsyl, Inc. It has not been cleared or approved by the US Food and Drug Administration (FDA). The FDA does not require this test to go through premarket review. This test is used for clinical purposes. It should not be regarded as investigational or for research. This laboratory is certified under the Clinical Laboratory Improvement Amendments of 1988 (CLIA) as qualified to perform high-complexity clinical testing. These results are adjunctive to the ordering physician's workup. CLIA Number: #05D1102604.

Lab Directors:

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Male

Name: DONOR 4713

DOB: [REDACTED]

Female

Not tested

Diseases Tested

ABCC8-Related Hyperinsulinism - Gene: ABCC8. Variants (3): F1388del, V187D, 3992-9G>A. Detection rate: Mixed or Other Caucasian <10%.

Bloom Syndrome - Gene: BLM. Variant (1): 2281del6ins7. Detection rate: Mixed or Other Caucasian <10%.

Canavan Disease - Gene: ASPA. Variants (4): E285A, Y231X, A305E, IVS2-2A>G. Detection rate: Mixed or Other Caucasian 53%.

Cystic Fibrosis - Gene: CFTR. Variants (99): G85E, R117H, R334W, R347P, A455E, G542X, G551D, R553X, R560T, R1162X, W1282X, N1303K, F508del, I507del, 2184delA, 3659delC, 621+1G>T, 711+1G>T, 1717-1G>A, 1898+1G>A, 2789+5G>A, 3120+1G>A, 3849+10kbC>T, E60X, R75X, E92X, Y122X, G178R, R347H, Q493X, V520F, S549N, P574H, M1101K, D1152H, 2143delT, 394delTT, 444delA, 1078delT, 3876delA, 3905insT, 1812-1G>A, 3272-26A>G, 2183AA>G, S549R(A>C), R117C, L206W, G330X, T338I, R352Q, S364P, G480C, C524X, S549R(T>G), Q552X, A559T, G622D, R709X, K710X, R764X, Q890X, R1066C, W1089X, Y1092X, R1158X, S1196X, W1204X(c.3611G>A), Q1238X, S1251N, S1255X, 3199del6, 574delA, 663delT, 935delA, 936delTA, 1677delTA, 1949del84, 2043delG, 2055del9>A, 2108delA, 3171delC, 3667del4, 3791delC, 1288insTA, 2184insA, 2307insA, 2869insG, 296+12T>C, 405+1G>A, 405+3A>C, 406-1G>A, 711+5G>A, 712-1G>T, 1898+1G>T, 1898+5G>T, 3120G>A, 457TAT>G, 3849+4A>G, Q359KT360K. Detection rate: Mixed or Other Caucasian 91%.

Familial Dysautonomia - Gene: IKBKAP. Variants (2): IVS20+6T>C, R696P. Detection rate: Mixed or Other Caucasian <10%.

Fanconi Anemia Type C - Gene: FANCC. Variants (3): IVS4+4A>T, 322delG, R548X. Detection rate: Mixed or Other Caucasian 54%.

Gaucher Disease - Gene: GBA. Variants (10): N370S, L444P, 84GG, IVS2+1G>A, V394L, R496H, D409H, D409V, R463C, R463H. Detection rate: Mixed or Other Caucasian 60%.

Glycogen Storage Disease Type Ia - Gene: G6PC. Variants (7): R83C, Q347X, Q27fsdelC, 459insTA, R83H, G188R, Q242X. Detection rate: Mixed or Other Caucasian 61%.

Hb Beta Chain-Related Hemoglobinopathy (Including Beta Thalassemia and Sickle Cell Disease) - Gene: HBB. Variants (28): Hb S, K17X, Q39X, Phe41fs, Ser9fs, IVS-II-654, IVS-II-745, IVS-II-850, IVS-I-6, IVS-I-110, IVS-I-5, IVS-I-1(G>A), -88C>T, -28A>G, -29A>G, Lys8fs, Phe71fs, IVS-II-849(A>C), IVS-II-849(A>G), Gly24 T>A, -87C>G, Hb C, W15X, Gly16fs, Glu6fs, Hb E, Hb D-Punjab, Hb O-Arab. Detection rate: Mixed or Other Caucasian 83%.

Hexosaminidase A Deficiency (Including Tay-Sachs Disease) - Gene: HEXA. Variants (9): 1278insTATC, IVS12+1G>C, G269S, IVS9+1G>A, R178H, IVS7+1G>A, 7.6kb del, G250D, R170W. Detection rate: Mixed or Other Caucasian 23%.

Lipoamide Dehydrogenase Deficiency - Gene: DLD. Variants (2): 105insA, G229C. Detection rate: Mixed or Other Caucasian <10%.

Maple Syrup Urine Disease Type 1B - Gene: BCKDHB. Variants (3): R183P, G278S, E372X. Detection rate: Mixed or Other Caucasian <10%.

Mucopolidosis IV - Gene: MCOLN1. Variants (2): 511_6944del, IVS3-2A>G. Detection rate: Mixed or Other Caucasian <10%.

Niemann-Pick Disease, SMPD1-Associated - Gene: SMPD1. Variants (4): fsP330, L302P, R496L, p.R608del. Detection rate: Mixed or Other Caucasian 38%.

Spinal Muscular Atrophy (copy number analysis only) - Gene: SMN1. Variant (1): SMN1 copy number. Detection rate: Mixed or Other Caucasian 95%.

Usher Syndrome Type 1F - Gene: PCDH15. Variant (1): R245X. Detection rate: Mixed or Other Caucasian <10%.

Usher Syndrome Type 3 - Gene: CLRN1. Variant (1): N48K. Detection rate: Mixed or Other Caucasian <10%.



Male
 Name: DONOR 4713
 DOB: [REDACTED]

Female
 Not tested

Risk Calculations

Below are the risk calculations for all diseases tested. Since negative results do not completely rule out the possibility of being a carrier, the residual risk represents the patient's post-test likelihood of being a carrier and the reproductive risk represents the likelihood the patient's future children could inherit each disease. These risks are inherent to all carrier screening tests, may vary by ethnicity, are predicated on a negative family history and are present even after a negative test result. Inaccurate reporting of ethnicity may cause errors in risk calculation.

Disease	DONOR 4713 Residual Risk	Reproductive Risk
ABCC8-Related Hyperinsulinism	1 in 110	1 in 50,000
Bloom Syndrome	< 1 in 500	< 1 in 1,000,000
Canavan Disease	< 1 in 500	< 1 in 1,000,000
Cystic Fibrosis	1 in 300	1 in 33,000
Familial Dysautonomia	< 1 in 500	< 1 in 1,000,000
Fanconi Anemia Type C	1 in 340	1 in 220,000
Gaucher Disease	1 in 280	1 in 120,000
Glycogen Storage Disease Type Ia	1 in 450	1 in 320,000
Hb Beta Chain-Related Hemoglobinopathy (Including Beta Thalassemia and Sickle Cell Disease)	1 in 290	1 in 58,000
Hexosaminidase A Deficiency (Including Tay-Sachs Disease)	1 in 390	1 in 470,000
Lipoamide Dehydrogenase Deficiency	< 1 in 500	< 1 in 1,000,000
Maple Syrup Urine Disease Type 1B	1 in 250	1 in 250,000
Mucopolysaccharidosis IV	< 1 in 500	< 1 in 1,000,000
Niemann-Pick Disease, SMPD1-Associated	1 in 400	1 in 400,000
Spinal Muscular Atrophy	SMN1: 2 copies 1 in 610	1 in 84,000
Usher Syndrome Type 1F	1 in 190	1 in 150,000
Usher Syndrome Type 3	< 1 in 500	< 1 in 1,000,000

Patient Information

Name: Donor 4713
 Date of Birth: [REDACTED]
 Sema4 ID: [REDACTED]
 Client ID: [REDACTED]
 Indication: Carrier Testing

Specimen Information

Specimen Type: DNA from semen
 Date Collected: 03/05/2020
 Date Received: 03/11/2020
 Final Report: 03/25/2020

Referring Provider

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

Custom Carrier Screen (ECS)

Number of genes tested: 1

SUMMARY OF RESULTS AND RECOMMENDATIONS

Negative

Negative for all genes tested: CBS

To view a full list of genes and diseases tested
 please see Table 1 in this report

AR=Autosomal recessive; XL=X-linked

Recommendations

- 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.

Test description

This patient was tested for the genes listed above using one or more of the following methodologies: target capture and short-read sequencing, long-range PCR followed by short-read sequencing, targeted genotyping, and/or 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 view the Table of Residual Risks Based on Ethnicity at the end of this report or at go.sema4.com/residualrisk for gene transcripts, sequencing exceptions, specific detection rates, and residual risk estimates after a negative screening result. With individuals of mixed ethnicity, it is recommended to use the highest residual risk estimate. Only known pathogenic or likely pathogenic variants are reported. This carrier screening test does not report likely benign variants and variants of uncertain significance (VUS). If reporting of likely benign variants and VUS are desired in this patient, please contact the laboratory at 800-298-6470, option 2 to request an amended report.

Anastasia Larmore, Ph.D., Assistant Laboratory Director

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

Genes and diseases tested

For specific detection rates and residual risk by ethnicity, please visit go.sema4.com/residualrisk

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

Disease	Gene	Inheritance Pattern	Status	Detailed Summary
⊖ Negative				
Homocystinuria (CBS-Related)	CBS	AR	Reduced Risk (see table below)	

AR=Autosomal recessive; XL=X-linked

Table 2: Residual Risk by ethnicity for negative results

Disease (Inheritance)	Gene	Ethnicity	Carrier Frequency	Detection Rate	Residual Risk	Analytical Detection Rate
Homocystinuria (CBS-Related) (AR) NM_000071.2	CBS	African	1 in 188	95%	1 in 3,500	97%
		Ashkenazi Jewish	1 in 330	90%	1 in 3,500	
		East Asian	1 in 589	73%	1 in 2,200	
		Finnish	1 in 336	94%	1 in 5,600	
		European (Non-Finnish)	1 in 142	90%	1 in 1,400	
		Native American	1 in 202	93%	1 in 3,100	
		South Asian	1 in 523	89%	1 in 5,000	
		Worldwide	1 in 179	91%	1 in 1,900	
		Qatari	1 in 21	86%	1 in 140	

* Carrier detection by HEXA enzyme analysis has a detection rate of approximately 98% (Applies to *HEXA* gene testing only).

† Carrier frequencies include milder and reduced penetrance forms of the disease. Therefore, carrier frequencies may appear higher than reported in the literature (Applies to *BTD*, *Fg*, *GJB2*, *GJB1*, *GLA*, and *MEFV* gene testing only).

‡ Please note that *GJB2* testing includes testing for the two upstream deletions, del(GJB6-D13S1830) and del(GJB6-D13S1854) (PMID:11807148 and 15994881) (Applies to *GJB2* gene testing only).
 AR: Autosomal recessive; N/A: Not available; 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:

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™ QXT 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. Samples were pooled and sequenced on the Illumina HiSeq 2500 platform in the Rapid Run mode or the Illumina NovaSeq platform in the Xp workflow, using 100 bp paired-end reads. This 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. The exons contained within these regions are noted within Table 1 (as "Exceptions") and 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® genotyping platform.

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.

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 array CGH 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/probesets 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 these 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 >28,000 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.

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.

SELECTED REFERENCES

Carrier Screening

Grody W et al. ACMG position statement on prenatal/preconception expanded carrier screening. *Genet Med*. 2013 15:482-3.

Variant Classification:



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.