

A Clinician's Guide to Expanded Carrier Screening



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The preconception care evaluation is designed to increase the chances of a woman having a healthy pregnancy and healthy baby by finding genetic changes that could affect the pregnancy before it actually begins. In addition to collecting a multi-generational family history, carrier screening offered ideally before conception provides the opportunity for couples to identify risks for their future offspring to inherit a genetic disorder.

In 2015, a joint statement regarding expanded carrier screening was released by several professional associations: the American College of Medical Genetics and Genomics (ACMG), the American College of Obstetricians and Gynecologists (ACOG), the National Society of Genetic Counselors (NSGC), the Perinatal Quality Foundation, and the Society for Maternal-Fetal Medicine (SMFM). Per this statement, professional practice guidelines currently recommend offering carrier screening to individuals based on condition severity, race or ethnicity, prevalence, carrier frequency, detection rates, and residual risk.

Given the ethnic admixture of the world's population, especially in the United States, the number of expanded carrier screens is growing for far more disorders than recommended by ACMG/ACOG. In fact, most expanded carrier screens include more than 100 genetic disorders; the analysis of which may require employing several test methodologies. While most disorders are detected via molecular methods such as high-throughput genotyping and sequencing, hemoglobinopathies such as sickle cell disease, for example, require hemoglobin electrophoresis and mean corpuscular volume included in complete blood counts. Another example would be the measurement of the hexosaminidase enzyme, as the most sensitive screen for Tay-Sachs disease.

This guide is designed to assist clinicians in understanding the value of expanded carrier screening and its importance for family planning.





What is expanded carrier screening?

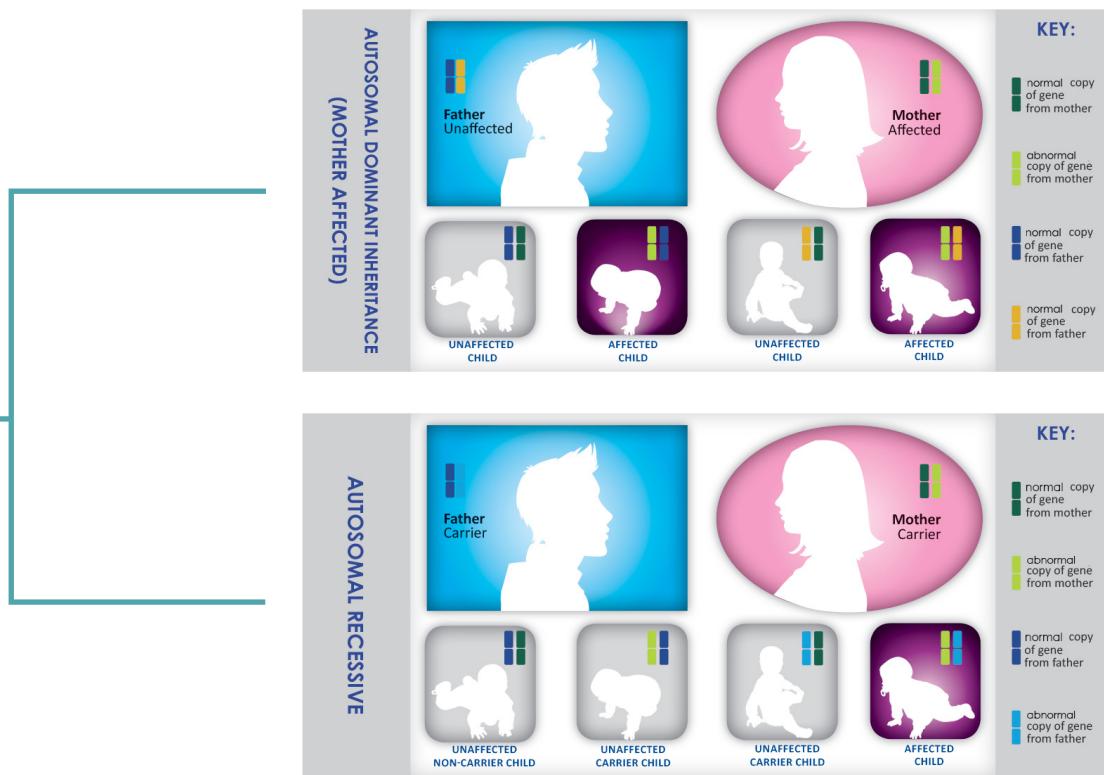
Expanded carrier screening is an important component of preconception planning and routine obstetric care. The purpose of this test is to identify couples and/or individuals at risk for passing genetic conditions to their children based on several factors including parental ethnicity. The majority of disorders screened are autosomal recessive disorders; however some carrier screens may include X-linked disorders.

What are autosomal disorders?

Autosomal disorders describe conditions caused by an abnormal copy of a gene located on one of the 22 non-sex chromosomes, also known as autosomal chromosomes. An autosomal recessive disorder develops when an individual inherits two abnormal copies of a gene; one abnormal copy from each carrier parent. Individuals who are carriers of recessive conditions have just one abnormal copy and usually do not display symptoms.

What are X-linked disorders?

X-linked disorders describe conditions caused by an abnormal gene located on the X chromosome. With X-linked inherited disorders, men are almost exclusively affected due to having one X and one Y chromosome. A male who inherits the abnormal copy of an X gene from his mother will display symptoms; however, he cannot pass the condition to his sons. Two abnormal copies of an X gene, one from each parent, are necessary for females to develop an X-linked recessive condition. Females who are carriers of X-linked recessive conditions rarely show symptoms; however, the few that do, result from X-inactivation (inactivation of one copy of the X chromosome in each female cell). For X-linked dominant conditions, the presence of one abnormal X gene is enough to display symptoms.





Which patients are appropriate for expanded carrier screening?

Expanded carrier screening is ideally a preconception tool, however, it is often offered during the prenatal period. Screening may be offered to individuals who plan to donate their gametes, as well as consanguineous couples due to the increased risk for their children to have an autosomal recessive condition.

Here are some general considerations before offering expanded carrier screening to your patients:

- Couples, regardless of ethnicity, should be offered screening for the same set of disorders.
- All individuals should be appropriately counseled before consenting to the screen. Pretest education should include a description of the types of disorders and the limitations of screening.
- Patients should understand that carrier screening is voluntary and results are kept confidential and protected by the Genetic Information Non-Discrimination Act.
- Expanded carrier screens include a large number of disorders; therefore it is common to identify carriers for one or more disorders. For most genetic disorders included on a carrier screen, both parents must have a pathogenic variant in the same gene in order for their offspring to be affected.
- Carrier screening may identify a patient with two pathogenic variants or mutations in the same gene which may cause current symptoms or later-onset disease for the patient.

How does expanded carrier screening benefit my patient?

Expanded carrier screening may benefit your patient in several ways. Carrier screening can assist in family planning by providing calculated risks for future offspring to have a specific genetic disorder. If a carrier screen comes back positive, additional genetic testing may be warranted in the form of prenatal genetic testing. If a couple is pregnant, prenatal genetic testing can be performed to determine if the baby has the same disease-causing alterations found in the parents. Prenatal and postnatal monitoring of the baby may also help identify which treatment and/or management strategies will work best if the baby is born with an inherited disorder.

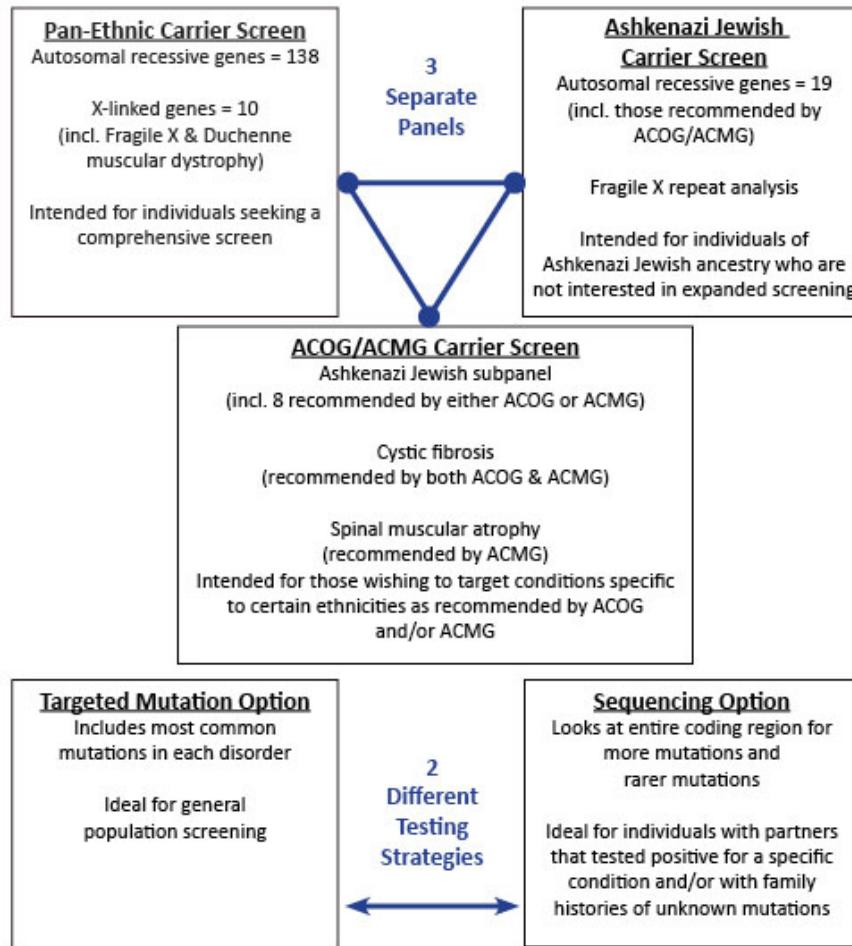


Carrier Screen Options- Find the Right Panel to Meet Your Patient's Needs

EGL offers several carrier screening options designed to meet a variety of clinician and patient needs:

- Pan-Ethnic Carrier Screen: Gene Sequencing Panel or Targeted Mutation Panel*
- ACOG/ACMG Carrier Screen: Gene Sequencing Panel or Targeted Mutation Panel
- Ashkenazi Jewish Carrier Screen: Gene Sequencing Panel or Targeted Mutation Panel*
- Spinal Muscular Atrophy: Carrier Screen
- Cystic Fibrosis: *CFTR* Common Mutation Panel
- Fragile X Syndrome: CGG Repeat Analysis*

*Please note these tests will be performed and reported on both male and female specimens. Because of the nature of X-linked inheritance, these tests, if positive, may be diagnostic for male patients in rare cases. If you do not wish to have X-linked conditions assessed in male patients, please contact the laboratory.



Pan-Ethnic Carrier Screen

The Pan-Ethnic Carrier Screen analyzes 138 genes that cause autosomal recessive disorders and 10 genes that cause X-linked recessive disorders. It includes testing for mobility disorders, development delay and intellectual disability, visual impairment, hearing loss, skin irregularities, joint and bone disorders, abnormalities of the nervous system, and numerous metabolic syndromes, including lysosomal storage disorders.

Most of the genetic disorders included in the panel lack treatment options, but some can be well-managed with diet or medication (eg. phenylketonuria (PKU) or biotinidase deficiency). Many of these conditions, however, can result in a shortened lifespan or require lifelong medical care. In addition, this panel includes screening for spinal muscular atrophy, the second most common lethal autosomal recessive disorder in Caucasians, and fragile X syndrome, the most common genetic form of intellectual disability in males.

A condition guide for clinicians, which features descriptions of each disorder, can be found on the EGL website: <http://geneticslab.emory.edu/pecs/Docs/Chart.pdf>.

Disorder	Gene	Disorder	Gene
Achromatopsia	CNGB3	Beta-Hemoglobinopathies (including Sickle Cell and Beta-Thalassemia)	HBB
Alpha-1 Antitrypsin Deficiency	SERPINA1	Beta-Ketothiolase Deficiency	ACAT1
Alpha-Mannosidosis	MAN2B1	Biotinidase Deficiency	BTD
Alpha-Thalassemia	HBA1	Bloom Syndrome	BLM
Alpha-Thalassemia	HBA2	Canavan Disease	ASPA
Andermann Syndrome	SLC12A6	Carnitine Deficiency, Primary	SLC22A5
Argininosuccinate Lyase Deficiency	ASL	Carnitine Palmitoyltransferase IA Deficiency	CPT1A
Aspartylglycosaminuria	AGA	Carnitine Palmitoyltransferase II Deficiency	CPT2
Ataxia With Vitamin E Deficiency	TPPA	Cartilage-Hair Hypoplasia	RMRP
Ataxia-Telangiectasia	ATM	Choroideremia	CHM
Autosomal Recessive Spastic Ataxia of Charlevoix-Saguenay (ARSACS)	SACS	Citrullinemia Type 1	ASS1
Bardet-Biedl Syndrome, Type 1	BBS1	Cohen Syndrome	VPS13B
Bardet-Biedl Syndrome, Type 10	BBS10	Combined Pituitary Hormone Deficiency	PROP1
Bernard-Soulier Syndrome, Type B	GP1BB	Congenital Adrenal Hyperplasia (CAH)	CYP21A2
Bernard-Soulier Syndrome, Type C	GP9		

Disorder	Gene	Disorder	Gene
Congenital Disorder of Glycosylation Type Ia	PMM2	Glycogen Storage Disease Type Ib (von Gierke)	SLC37A4
Congenital Disorder of Glycosylation Type Ib	MPI	Glycogen Storage Disease Type III (Cori/Forbes)	AGL
Costeff Optic Atrophy Syndrome	OPA3	Glycogen Storage Disease Type V (McArdle)	PYGM
Cystic Fibrosis	CFTR	GRACILE Syndrome	BCS1L
Cystinosis	CTNS	Growth Hormone Deficiency, Isolated	GHRHR
D-Bifunctional Protein Deficiency	HSD17B4	Hearing Loss, Non-syndromic (a.k.a Connexin 26)	GJB2
Dihydrolipoamide Dehydrogenase Deficiency (a.k.a Maple Syrup Urine Disease Type 3)	DLD	Hearing Loss, Non-syndromic (a.k.a Connexin 30)	GJB6
Dihydropyrimidine Dehydrogenase Deficiency	DPYD	Heme Oxygenase 1 Deficiency	HMOX1
Duchenne/Becker Muscular Dystrophy	DMD	Hemochromatosis	HFE
Fabry Disease	GLA	Hemophilia B	F9
Factor XI Deficiency	F11	Hereditary Fructose Intolerance	ALDOB
Familial Dysautonomia	IKBKA	Herlitz Junctional Epidermolysis Bullosa, LAMA3-Related	LAMA3
Familial Mediterranean Fever	MEFV	Herlitz Junctional Epidermolysis Bullosa, LAMB3-Related	LAMB3
Fanconi Anemia Type C	FANCC	Herlitz Junctional Epidermolysis Bullosa, LAMC2-Related	LAMC2
Finnish Nephrosis (a.k.a Nephrotic Syndrome Type 1)	NPHS1	Homocystinuria, CBS-deficient	CBS
Fumarase Deficiency	FH	Hydatidiform Mole, Recurrent	NLRP7
Galactosemia	GALT	Hyperinsulinism	ABCC8
Gaucher Disease	GBA	Hyperoxaluria, Primary Type 1	AGXT
Glaucoma, Primary Congenital	CYP1B1	Hyperoxaluria, Primary Type 2	GRHPR
Glucose-6-Phosphate Dehydrogenase Deficiency	G6PD	Hypohidrotic Ectodermal Dysplasia	EDAR
Glutaric Acidemia Type 1	GCDH		
Glycogen Storage Disease Type Ia (von Gierke)	G6PC		

Disorder	Gene	Disorder	Gene
Hypophosphatasia	<i>ALPL</i>	Mucolipidosis Type II/IIIA	<i>GNPTAB</i>
Inclusion Body Myopathy 2	<i>GNE</i>	Mucolipidosis Type IV	<i>MCOLN1</i>
Isovaleric Acidemia	<i>IVD</i>	Mucopolysaccharidosis Type I (Hurler)	<i>IDUA</i>
Joubert Syndrome 2	<i>TMEM216</i>	Mucopolysaccharidosis Type II (Hunter)	<i>IDS</i>
Krabbe Disease	<i>GALC</i>	Mucopolysaccharidosis Type IIIA (Sanfilippo A)	<i>SGSH</i>
Limb-Girdle Muscular Dystrophy Type 2A	<i>CAPN3</i>	Mucopolysaccharidosis Type IIIB (Sanfilippo B)	<i>NAGLU</i>
Limb-Girdle Muscular Dystrophy Type 2C	<i>SGCG</i>	Mucopolysaccharidosis Type IVA (Morquio A)	<i>GALNS</i>
Limb-Girdle Muscular Dystrophy Type 2D	<i>SGCA</i>	Mucopolysaccharidosis Type IVB (Morquio B)	<i>GLB1</i>
Limb-Girdle Muscular Dystrophy Type 2E	<i>SGCB</i>	Mucopolysaccharidosis Type VI (Maroteaux-Lamy)	<i>ARSB</i>
Long Chain 3-Hydroxyacyl-CoA Dehydrogenase Deficiency	<i>HADHA</i>	Mucopolysaccharidosis Type VII (Sly)	<i>GUSB</i>
Maple Syrup Urine Disease Type 1A	<i>BCKDHA</i>	Muscle-Eye-Brain Disease	<i>POMGNT1</i>
Maple Syrup Urine Disease Type 1B	<i>BCKDHB</i>	Nemaline Myopathy	<i>NEB</i>
Maple Syrup Urine Disease Type 2	<i>DBT</i>	Nephrotic Syndrome Type 2	<i>NPHS2</i>
Medium Chain Acyl-CoA Dehydrogenase Deficiency	<i>ACADM</i>	Neuronal Ceroid Lipofuscinosis Type 1	<i>PPT1</i>
Megalencephalic Leukoencephalopathy with Subcortical Cysts	<i>MLC1</i>	Neuronal Ceroid Lipofuscinosis Type 2	<i>TPP1</i>
Megaloblastic Anemia Syndrome	<i>SLC19A2</i>	Neuronal Ceroid Lipofuscinosis Type 3	<i>CLN3</i>
Metachromatic Leukodystrophy	<i>ARSA</i>	Neuronal Ceroid Lipofuscinosis Type 5	<i>CLN5</i>
Methylmalonic Acidemia, cblA Type	<i>MMAA</i>	Neuronal Ceroid Lipofuscinosis Type 8 (a.k.a Northern Epilepsy)	<i>CLN8</i>
Methylmalonic Acidemia, cblB-Type	<i>MMAB</i>	Niemann-Pick Disease Type A & B (a.k.a. Acid Sphingomyelinase Deficiency)	<i>SMPD1</i>
Methylmalonic Acidemia, mut-Type	<i>MUT</i>	Niemann-Pick Disease Type C1	<i>NPC1</i>
Methylmalonic Acidemia and Homocystinuria, cblC Type	<i>MMACHC</i>	Niemann-Pick Disease Type C2	<i>NPC2</i>

Disorder	Gene	Disorder	Gene
Nijmegen Breakage Syndrome	<i>NBN</i>	Sjogren-Larsson Syndrome	<i>ALDH3A2</i>
Oculocutaneous Albinism Type 1	<i>TYR</i>	Skeletal Dysplasias, SLC26A2-related	<i>SLC26A2</i>
Ornithine Transcarbamylase Deficiency	<i>OTC</i>	Smith-Lemli-Opitz Syndrome	<i>DHCR7</i>
Pantothenate Kinase-associated Neurodegeneration	<i>PANK2</i>	Tay Sachs Disease (a.k.a. Hexosaminidase A Deficiency)	<i>HEXA</i>
Papillon-Lefevre Syndrome (also Haim-Munk Syndrome)	<i>CTSC</i>	Tricho-Hepato-Enteric Syndrome	<i>TTC37</i>
Pendred Syndrome	<i>SLC26A4</i>	Tyrosinemia Type I	<i>FAH</i>
Phenylalanine Hydroxylase Deficiency (PKU)	<i>PAH</i>	Usher Syndrome Type 1F	<i>PCDH15</i>
Polycystic Kidney Disease, Autosomal Recessive	<i>PKHD1</i>	Usher Syndrome Type 3	<i>CLRN1</i>
Polyglandular Autoimmune Syndrome Type 1	<i>AIRE</i>	Very Long Chain Acyl-CoA Dehydrogenase Deficiency	<i>ACADVL</i>
Pompe Disease (a.k.a Glycogen Storage Disease Type 2 or Acid Maltase Deficiency)	<i>GAA</i>	Walker- Warburg Syndrome, Type 4	<i>FKTN</i>
Progressive Pseudorheumatoid Dysplasia	<i>WISP3</i>	Werner Syndrome	<i>WRN</i>
Pycnodysostosis	<i>CTSK</i>	Wilson Disease	<i>ATP7B</i>
Retinoschisis, Juvenile	<i>RS1</i>	Woolly Hair/ Hypotrichosis Syndrome	<i>LIPH</i>
Rett Syndrome	<i>MECP2</i>	Zellweger Spectrum Disorder Type 1 (a.k.a Infantile Refsum Disease)	<i>PEX1</i>
Rhizomelic Chondrodyplasia Punctata Type 1	<i>PEX7</i>		
Salla Disease (a.k.a Sialic Acid Storage Disease)	<i>SLC17A5</i>		
Sandhoff Disease	<i>HEXB</i>		
Segawa Syndrome	<i>TH</i>		
Short Chain Acyl-CoA Dehydrogenase Deficiency	<i>ACADS</i>		

ACOG/ACMG Carrier Screen

ACOG and ACMG both recommend carrier screening for a number of genetic disorders. The ACOG/ACMG Carrier Screen includes all disorders recommended by these associations.

ACOG/ACMG Carrier Screen	
Bloom Syndrome	Gaucher Disease
Canavan Disease	Mucolipidosis Type IV
Cystic Fibrosis	Niemann-Pick Disease Type A & B
Familial Dysautonomia	Spinal Muscular Atrophy
Fanconi Anemia Type C	Tay Sachs Disease (Hexosaminidase A Deficiency)

Ashkenazi Jewish Carrier Screen

Individuals of Ashkenazi Jewish descent are at a higher risk than the general population to be carriers of certain genetic disorders. This panel includes 20 disorders, including those recommended by ACOG and ACMG for those of Ashkenazi Jewish descent and additional disorders that occur more frequently in this population. Fragile X syndrome and spinal muscular atrophy are also included on this panel.

Ashkenazi Jewish Carrier Screen	
Bloom Syndrome	Maple Syrup Urine Disease Type 1B
Canavan Disease	Maple Syrup Urine Disease Type 3 (Dihydrolipoamide Dehydrogenase Deficiency)
Cystic Fibrosis	Mucolipidosis Type IV
Familial Dysautonomia	Nemaline Myopathy
Fanconi Anemia Type C	Niemann-Picks Disease Types A & B (Acid Sphingomyelinase Deficiency)
Fragile X Syndrome	Spinal Muscular Atrophy
Gaucher Disease	Tay-Sachs Disease (Hexosaminidase A Deficiency)
Glycogen Storage Disease Type 1A (von Gierke)	Usher Syndrome Type 1F
Hyperinsulinism	Usher Syndrome Type 3
Joubert Syndrome 2	Walker-Warburg Syndrome Type 4

Spinal muscular atrophy

Spinal muscular atrophy (SMA) is the second most common lethal, autosomal recessive disorder in Caucasians, with an incidence of approximately 1 in 10,000 and a carrier frequency of 1 in 50. The SMA carrier screen tests for the common *SMN1* deletion only; point mutations will not be detected and *SMN2* copy number will not be reported. 2% of individuals with spinal muscular atrophy have one *SMN1* allele resulting from a de novo mutation, meaning that only one parent is a carrier of an *SMN1* mutation. In the general population, most people have one copy of *SMN1* on each chromosome; however, approximately 5-8% of the population has two *SMN1* copies on the same chromosome (in cis) and some carriers will have an *SMN1* intragenic mutation that is not detected by this carrier screening.

Cystic Fibrosis: *CFTR* Common Mutation Panel

Cystic fibrosis (CF) is a chronic multisystem genetic condition caused by pathogenic variants in the *CFTR* gene. Classic CF primarily involves the respiratory and digestive systems, and may have a range of clinical severity. Pulmonary symptoms often include lower airway inflammation, chronic cough, chronic sinusitis, and recurrent infections. Digestive symptoms often include meconium ileus, pancreatic insufficiency resulting in malabsorption and/or failure to thrive, diabetes mellitus, and hepatobiliary disease. Congenital bilateral absence of the vas deferens (CBAVD) is seen in men without pulmonary or digestive symptoms of CF, and results in azoospermia. CBAVD is a significant cause of male infertility.

CF carrier frequency is estimated to be approximately 1 in 25 in the Caucasian population, 1 in 24 in the Ashkenazi Jewish population, 1 in 61 in the African American population, 1 in 58 in the Hispanic population, and 1 in 94 in the Asian population. This panel tests for the 39 most common *CFTR* mutations, including the core panel of 23 mutations for cystic fibrosis as recommended by the American College of Medical Genetics in 2004. An expanded cystic fibrosis screening panel is also available, which includes 142 *CFTR* mutations.

Fragile X Syndrome: CGG Repeat Analysis

Fragile X syndrome is characterized by moderate intellectual disability, particularly in males. It has a prevalence of 1 in 4000 to 1 in 6000 in the general population, and is a leading genetic cause of intellectual disability. Females with fragile X may have a variable clinical presentation due to X-inactivation. Intellectual disability in females is typically mild.

Expansion of a CGG triplet repeat leading to DNA methylation and silencing of the *FMR1* gene is the most frequent cause of fragile X syndrome. However, other pathogenic variants within the *FMR1* gene have also been identified as causing fragile X syndrome. In individuals with normal alleles, the number of CGG repeats ranges from approximately 5-44. Individuals with approximately 55-200 CGG repeats are permutation carriers. Individuals with fragile X syndrome have over 200 CGG repeats. Males with over 200 repeats are almost always affected.

Targeted Mutations Listing and Risk Calculator

A listing of targeted mutations is available for each screen. Each list includes nucleotide changes, protein changes, and an alias listing for genes included on each panel. These listings can be accessed through <http://geneticslab.emory.edu/pecs/>.

EGL provides a risk calculation for inheriting autosomal recessive and X-linked genetic disorders according to ethnicity. A chart detailing detection rates, carrier risks prior to testing, and both pre- and post-test reproductive risks can be generated. Residual reproductive risks are calculated assuming the patient is not a carrier for any condition on the panel and that the partner has not been tested. Risks for fragile X are calculated differently and are based on repeat number. The chart generated will only take into account couples tested by EGL.



Sample Report

EGL reporting has been optimized to provide complex results in an intuitive manner. Any genetic changes are clearly indicated on the first page, followed by carrier and residual risk information by disorder, based on the patient's results.

MM480: Pan-Ethnic Carrier Screen - Targeted Mutation Panel

Report Prepared For:

Patient:

Name:
Date of Birth:
IDs (Internal / External):
Reported Gender: Reported
Ethnicity:

Sample:

Sample Collection Date: Sample
Received Date: Final Report
Date: Sample Type:
Sample Internal Identifier:

Report Summary:

Autosomal Carrier Screening Results:**Positive Carrier**

This individual tested positive as a carrier of the following disease(s). None of the other autosomal recessive mutations on the panel were detected. Mutations other than those on the panel will not be detected.

Isovaleric Acidemia

IVD:NM_002225.3:c.941C>T (p.Ala314Val)

Positive Carrier Result Details:

Isovaleric Acidemia**IVD**

Isovaleric acidemia is caused by an inability of the body to properly break down isoformic acid into smaller substances. Although some people this condition do not show any symptoms, most start with poor feeding, vomiting, and problems staying warm. There can be periods between episodes without any symptoms. If untreated, it could progress to seizures, learning disabilities, and organ failure. The excess isoformic acid in the body can also cause a "sweaty feet" odor. Diet and medication can help lessen the effects of this condition.

This condition is inherited in an autosomal recessive manner which means both parents have to be carriers to have a 1 in 4 (25%) risk to have an affected child. Being a carrier does not mean you are affected with this condition, but it can increase the risk for you to have affected children. These risks will vary depending on the carrier status of your partner, and it is recommended that you discuss these results and the available follow-up testing options with your healthcare provider. You may also wish to share your results with other family members so they can consider testing as their risks for being a carrier is also increased.

Variants Detected:

IVD:NM_002225.3:c.941C>T
(p.Ala314Val) Prior Reproductive Risk: 1 in 250,000 Current Reproductive Risk: <see below>

*(Specific to partners of reported ethnicity prior to testing)
(Please see table below)*

Current Reproductive Risk:**Partner Ethnicity:****Partner Is Untested: (1)****Partner is Negative: (1, 2)****Partner is a Carrier:**

African American Asian	1 in 1,000	1 in 1,100	1 in 4
European / Caucasian	1 in 1,000	1 in 1,100	1 in 4
Finnish	1 in 1,000	1 in 1,100	1 in 4
Hispanic	1 in 1,000	1 in 1,100	1 in 4
Ashkenazi Jewish	1 in 1,000	1 in 1,100	1 in 4
Other / Mixed	1 in 1,000	1 in 1,100	1 in 4
	1 in 1,000	1 in 1,100	1 in 4

1 - Based upon the partner's general population carrier rate for the given ethnicity (available upon request). 2 - Based upon the partner testing negative for the mutations on this carrier screen and the detection rate for the ethnicity given (available upon request).

Residual Carrier Risks:

The following prior risks are based upon incidence/cARRIER rates published in the scientific literature, the patient's reported ethnicity, and that the patient does not have a family history of the disease. The residual risks are based upon the disease-specific detection rates and reflect remaining risk to be a carrier after a negative screening result. Residual risks in males for X-linked conditions will not be displayed as the reproductive risk falls primarily with the female partner. For more information or for calculation of reproductive risks in various partner-testing scenarios, please refer to our website at <http://geneticslab.emory.edu/pecs/>.

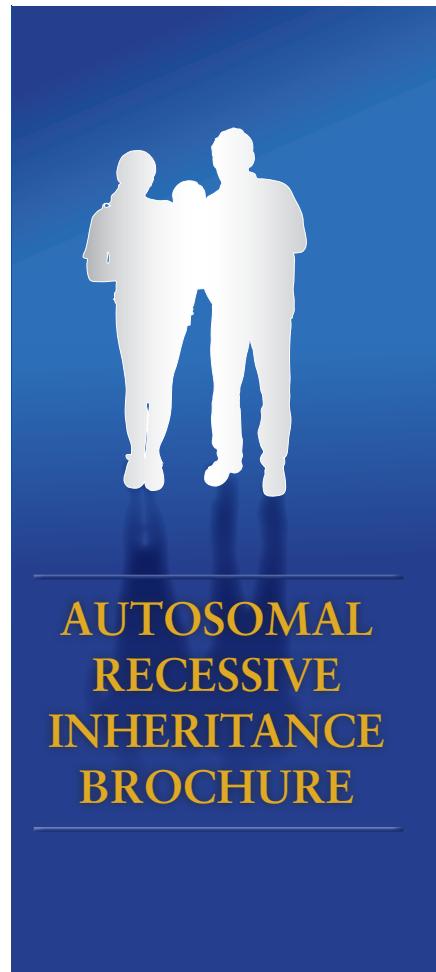
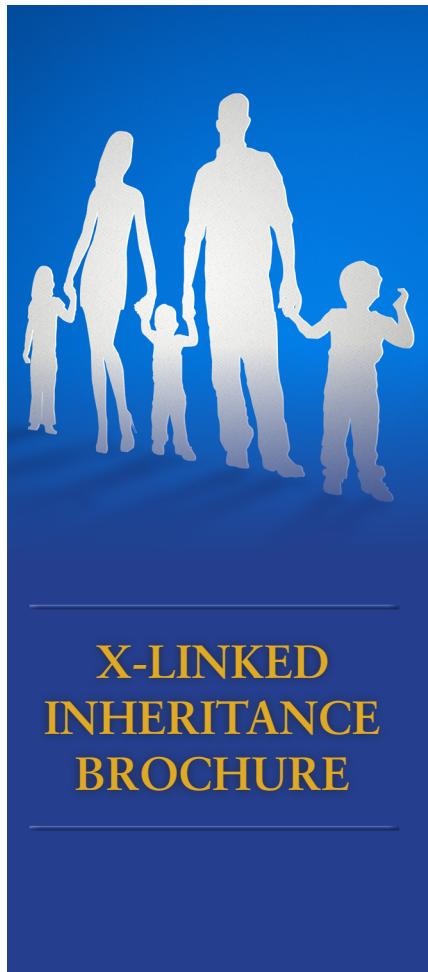
The incidence/cARRIER rates are based on our current understanding of the conditions and genes on this panel. These rates may change over time as more information about the conditions and genes and their incidence in the general population becomes available.

Carrier Risk: **Residual:**

Condition (Gene):	Prior:	
Achromatopsia (CNGB3)	1 in 410	1 in 680
Alpha-1 Antitrypsin Deficiency (SERPINA1)	1 in 35	1 in 690
Alpha-Mannosidosis (MAN2B1)	1 in 270	1 in 370
Andermann Syndrome (SLC12A6)	1 in 500	1 in 560

Patient Resources

At EGL, we know it is important to communicate this seemingly complicated information to your patients in a way they can easily understand. We offer pamphlets to help patients understand carrier screening and inheritance patterns for disorders screened by EGL. To order these resources, please contact EGL.



Why choose EGL for expanded carrier screening?

EGL is the only genetics laboratory offering deletion and duplication analyses for the *HBA1/HBA2*, *CFTR*, *MECP2*, and *DMD* genes, as part of its Pan-Ethnic Carrier Screen. In addition to offering these analyses, EGL is also a leader in Duchenne muscular dystrophy carrier screening and diagnostic testing.

If a variant is detected, EGL can perform known mutation testing for the partner. This form of targeted testing looks for the specific genetic change(s) also found in the partner.

As EGL offers molecular genetics, biochemical genetics, and cytogenetic testing under one roof, comprehensive prenatal and postnatal genetic testing can be performed, including full gene or targeted mutation analysis, deletion and duplication testing, SNP and oligo microarrays, karyotyping, FISH, and enzyme and protein quantifications.

Established in 1970, EGL has more clinical experience than any other genetics laboratory in the United States. Highly skilled, board-certified laboratory directors and genetic counselors report out each case and custom testing for all medically relevant genes is available for domestic and international clients.

References:

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