Methylmalonic Aciduria and Homocystinuria, cbIC Type: MMACHC Gene Deletion/Duplication

**Test Code:** DMACH  
**Turnaround time:** 2 weeks  
**CPT Codes:** 81228 x1

### Condition Description

Vitamin B\textsubscript{12} (cobalamin) is a cofactor required by two enzymes, methionine synthase (MTR) and methylmalonyl-CoA mutase (MUT). Disorders of intracellular cobalamin metabolism may impair the function of either or both enzymes:

- Clinical syndromes involving defects in MUT function alone are called methylmalonic acidemia. Such defects can be caused by defective MUT enzyme or missing B\textsubscript{12} cofactor. Certain subtypes of methylmalonic acidemia may be further defined by complementation analysis. Complementation groups causing isolated methylmalonic acidemia include cblA and cblB.

- Clinical syndromes involving defective MTR function can be caused by defective MTR enzyme, missing cofactor, or defects in an enzyme that regenerates MTR: methionine synthase reductase (MTRR). Defective MTR function is associated with variable hyperhomocysteinemia and/or homocystinuria.

- Disorders that cause isolated defects in MTR function, as well as disorders that cause combined defects in both MTR and MUT function, are named by complementation group. MTR-only and combined MUT/MTR cobalamin disorders include cbIC, cbID, cbID variant 1, cbID variant 2, cbIE, cbIF, and cbIG.

The clinical manifestations of disorders of intracellular cobalamin metabolism, identified by complementation class as cbIC, cbID, cbID variant 1, cbID variant 2, cbIF, cbIE, and cbIG, can be highly variable even within a single complementation class. cbIC is the most common of these disorders. The age of onset presentation of cbIC ranges from (1) newborns who can be small for gestational age (SGA) and have microcephaly; to (2) infants who can have poor feeding, failure to thrive, pallor, and neurologic signs, and occasionally hemolytic uremic syndrome (HUS) and/or seizures including infantile spasms; to (3) toddlers who can have failure to thrive, poor head growth, cytopenias (including megaloblastic anemia), global developmental delay, encephalopathy, and neurologic signs such as hypotonia and seizures; and to (4) young adults/adults who can have confusion, other mental status changes, cognitive decline, and megaloblastic anemia.

Metabolic screening tests such as urine organic acid analysis and plasma amino acid analysis help to categorize the clinical syndrome. Analysis in specialized laboratories can establish the specific complementation class. Mutations in the *MMACHC* (1p34.1) gene cause cbIC. The role of molecular genetic testing in diagnosis is evolving; molecular genetic testing may be faster and less expensive than complementation class analysis in establishing a specific diagnosis in a family.

All disorders of intracellular cobalamin metabolism are inherited in an autosomal recessive manner. Heterozygotes (carriers) are asymptomatic.

For patients with suspected cbIC, sequence analysis is recommended as the first step in mutation identification. For patients in whom mutations are not identified by full gene sequencing, deletion/duplication analysis is appropriate.

[Click here](#) for the GeneTests summary on this condition.

### Genes

**MMACHC**

### Indications

This test is indicated for:

- Confirmation of a clinical/biochemical diagnosis of cbIC in an individual in whom sequence analysis is negative
- Carrier testing in adults with a family history of cbIC in whom sequence analysis is negative

### Methodology

DNA isolated from peripheral blood is hybridized to a CGH array to detect deletions and duplications. The targeted CGH array has overlapping probes which cover the entire genomic region.

### Detection

Detection is limited to duplications and deletions. The CGH array will not detect point or intronic mutations.

Results of molecular analysis must be interpreted in the context of the patient’s clinical and/or biochemical phenotype.

### Specimen Requirements

Submit only 1 of the following specimen types

**Type:** DNA, Isolated

**Specimen Requirements:**

Microtainer
3µg Isolation using the Perkin Elmer™Chemagen™ Automated Extraction method or Qiagen™ Puregene kit for DNA extraction is recommended.

**Specimen Collection and Shipping:**
Refrigerate until time of shipment in 100 ng/µL in TE buffer. Ship sample at room temperature with overnight delivery.

**Type: Whole Blood (EDTA)**

**Specimen Requirements:**
EDTA (Purple Top)
- Infants and Young Children (2 years of age to 10 years old): 3-5 ml
- Older Children & Adults: 5-10 ml
- Autopsy: 2-3 ml unclotted cord or cardiac blood

**Specimen Collection and Shipping:**
Ship sample at room temperature for receipt at EGL within 24 hours of collection. Do not refrigerate or freeze.

**Special Instructions**
Submit copies of diagnostic biochemical test results with the sample, if appropriate. Contact the laboratory if further information is needed.

Sequence analysis is required before deletion/duplication analysis by targeted CGH array. If sequencing is performed outside of EGL Genetics, please submit a copy of the sequencing report with the test requisition.

**Related Tests**
- Sequencing analysis of the **MMACHC** gene is available and is required before deletion/duplication analysis.
- Prenatal testing is available to couples who are confirmed carriers of mutations. Please contact the laboratory genetic counselor to discuss appropriate testing prior to collecting a prenatal specimen.