

## Overview

### Useful For

Follow up for abnormal biochemical results suggestive of congenital lactic acidosis

Establishing a molecular diagnosis for patients with congenital lactic acidosis

Identifying variants within genes known to be associated with congenital lactic acidosis, allowing for predictive testing of at-risk family members

### Reflex Tests

Test Id	Reporting Name	Available Separately	Always Performed
CULFB	Fibroblast Culture for Genetic Test	Yes	No

### Genetics Test Information

This test utilizes next-generation sequencing (NGS) to detect single nucleotide and copy number variants in 28 genes associated with congenital lactic acidosis: *ACAD9*, *AGK*, *DLD*, *ECHS1*, *FBXL4*, *FLAD1*, *FOXRED1*, *GFER*, *HADHA*, *HADHB*, *HLCS*, *MRPL3*, *MRPS22*, *NDUFB11*, *NDUFS4*, *OGDH*, *PC*, *PDHA1*, *PDHX*, *PDP1*, *SLC19A2*, *SLC19A3*, *SLC25A19*, *SUCLG1*, *TMEM70*, *TPK1*, *UQCRC2*, *VAR2*.

See [Targeted Genes and Methodology Details for Congenital Lactic Acidosis Panel](#) in Special Instructions and Method Description for additional details.

Additionally, mitochondrial genome sequencing including amplification of the entire mitochondrial genome by long-range polymerase chain reaction (LRPCR) followed by sequencing on the NGS platform is included to evaluate for variants within the mitochondrial genome.

Identification of a pathogenic variant may assist with diagnosis, prognosis, clinical management, familial screening, and genetic counseling for disorders causing congenital lactic acidosis.

Additional first tier testing may be considered/recommended. For more information see Ordering Guidance.

### Testing Algorithm

For skin biopsy or cultured fibroblast specimens, fibroblast culture testing will be performed at an additional charge. If viable cells are not obtained, the client will be notified.

### Special Instructions

- [Molecular Genetics: Biochemical Disorders Patient Information](#)
- [Informed Consent for Genetic Testing](#)
- [Blood Spot Collection Card-Spanish Instructions](#)
- [Blood Spot Collection Card-Chinese Instructions](#)
- [Informed Consent for Genetic Testing \(Spanish\)](#)

- [Blood Spot Collection Instructions](#)
- [Targeted Genes and Methodology Details for Congenital Lactic Acidosis Panel](#)

## Method Name

Sequence Capture and Targeted Next-Generation Sequencing followed by Polymerase Chain Reaction (PCR) and Sanger Sequencing/Long-Range Polymerase Chain Reaction (L-RPCR) followed by Next-Generation Sequencing (NGS)

## NY State Available

Yes

## Specimen

### Specimen Type

Varies

### Ordering Guidance

The recommended first-tier tests to screen for an underlying biochemical etiology for congenital lactic acidosis (CLA) are a combination of the following:

Lactic acid in blood

LASF1 / Lactic acid, Spinal Fluid

ACRN / Acylcarnitines, Quantitative, Plasma

OAU /Organic Acids Screen, Random, Urine

AAQP / Amino Acids, Quantitative, Plasma

PDHC / Pyruvate Dehydrogenase Complex, Fibroblasts

Pyruvate carboxylase activity

Customization of this panel and single gene analysis for any gene present on this panel is available. For more information see CGPH / Custom Gene Panel, Hereditary, Next-Generation Sequencing, Varies.

### Shipping Instructions

Specimen preferred to arrive within 96 hours of collection.

### Specimen Required

**Patient Preparation:** A previous bone marrow transplant from an allogenic donor will interfere with testing. Call 800-533-1710 for instructions for testing patients who have received a bone marrow transplant.

**Submit only 1 of the following specimens:**

**Specimen Type:** Whole blood

**Container/Tube:**

**Preferred:** Lavender top (EDTA) or yellow top (ACD)

**Acceptable:** Any anticoagulant

**Specimen Volume:** 3 mL

**Collection Instructions:**

1. Invert several times to mix blood.
2. Send specimen in original tube. **Do not** aliquot.

**Specimen Stability Information:** Ambient (preferred) 4 days/Refrigerated 14 days

**Specimen Type:** Skin biopsy

**Supplies:** Fibroblast Biopsy Transport Media (T115)

**Container/Tube:** Sterile container with any standard cell culture media (eg, minimal essential media, RPMI 1640). The solution should be supplemented with 1% penicillin and streptomycin.

**Specimen Volume:** 4-mm punch

**Specimen Stability Information:** Refrigerated (preferred)/Ambient

**Additional Information:** A separate culture charge will be assessed under CULFB / Fibroblast Culture for Biochemical or Molecular Testing. An additional 3 to 4 weeks is required to culture fibroblasts before genetic testing can occur.

**Specimen Type:** Cultured fibroblast

**Container/Tube:** T-25 flask

**Specimen Volume:** 2 Flasks

**Collection Instructions:** Submit confluent cultured fibroblast cells from a skin biopsy from another laboratory. Cultured cells from a prenatal specimen will not be accepted.

**Specimen Stability Information:** Ambient (preferred)/Refrigerated (<24 hours)

**Additional Information:** A separate culture charge will be assessed under CULFB / Fibroblast Culture for Biochemical or Molecular Testing. An additional 3 to 4 weeks is required to culture fibroblasts before genetic testing can occur.

**Specimen Type:** Blood spot

**Supplies:** Card-Blood Spot Collection (Filter Paper) (T493)

**Container/Tube:**

**Preferred:** Collection card (Whatman Protein Saver 903 Paper)

**Acceptable:** PerkinElmer 226 (formerly Ahlstrom 226) filter paper, or blood spot collection card

**Specimen Volume:** 5 Blood spots

**Collection Instructions:**

1. An alternative blood collection option for a patient older than 1 year is a fingerstick. For detailed instructions, see [How to Collect Dried Blood Spot Samples](#).
2. Let blood dry on the filter paper at ambient temperature in a horizontal position for a minimum of 3 hours.
3. Do not expose specimen to heat or direct sunlight.
4. Do not stack wet specimens.
5. Keep specimen dry.

**Specimen Stability Information:** Ambient (preferred)/Refrigerated

**Additional Information:**

1. Due to lower concentration of DNA yielded from blood spot, it is possible that additional specimen may be required to complete testing.
2. For collection instructions, see [Blood Spot Collection Instructions](#)
3. For collection instructions in Spanish, see [Blood Spot Collection Card-Spanish Instructions](#) (T777)
4. For collection instructions in Chinese, see [Blood Spot Collection Card-Chinese Instructions](#) (T800)

**Forms**

1. **New York Clients-Informed consent is required.** Document on the request form or electronic order that a copy is on

file. The following documents are available in Special Instructions:

-[Informed Consent for Genetic Testing](#) (T576)

-[Informed Consent for Genetic Testing \(Spanish\)](#) (T826)

2. [Molecular Genetics: Biochemical Disorders Patient Information](#) (T527) in Special Instructions

3. If not ordering electronically, complete, print, and send a [Biochemical Genetics Test Request](#) (T798) with the specimen.

## Specimen Minimum Volume

See Specimen Required

## Reject Due To

All specimens will be evaluated at Mayo Clinic Laboratories for test suitability.

## Specimen Stability Information

Specimen Type	Temperature	Time	Special Container
Varies	Varies		

## Clinical & Interpretive

### Clinical Information

Congenital lactic acidosis (CLA) is a rare, but serious, condition that presents in newborns with extreme elevations of lactic acid and is caused by a variety of biochemical disorders, resulting in impaired mitochondrial activity. Elevated lactate in multiple specimen types such as blood and cerebrospinal fluid (CSF) are typically observed. However, additional symptoms are extremely variable, as any high-energy organ or tissue may be impaired, resulting in a need for multisystem screening that may involve biopsies and biochemical analysis. CLA can be caused by pathogenic variants in genes encoding enzymes involved in gluconeogenesis, pyruvate oxidation, the Krebs cycle, and mitochondrial function.

A comprehensive gene panel with mitochondrial genome analysis is an essential tool to establish a diagnosis for patients with congenital lactic acidosis. As biomarker testing and multisystem organ assessments are not specific and can yield complex results, genetic testing is required to distinguish among the spectrum of conditions that can cause CLA. This panel analyzes a combination of nuclear genes for single-gene biochemical disorders known to cause CLA, as well as analysis of the mitochondrial genome.

### Reference Values

An interpretive report will be provided.

### Interpretation

All detected alterations are evaluated according to American College of Medical Genetics and Genomics (ACMG) recommendations.(1) Variants are classified based on known, predicted, or possible pathogenicity and reported with interpretive comments detailing their potential or known significance.

### Cautions

Clinical Correlations:

Test results should be interpreted in the context of clinical findings, family history, and other laboratory data.

Misinterpretation of results may occur if the information provided is inaccurate or incomplete.

If testing was performed because of a clinically significant family history, it is often useful to first test an affected family member. Detection of at least one reportable variant in an affected family member would allow for more informative testing of at-risk individuals.

To discuss the availability of additional testing options or for assistance in the interpretation of these results, contact the Mayo Clinic Laboratory genetic counselors at 800-533-1710.

#### Technical Limitations:

Next-generation sequencing may not detect all types of genomic variants. In rare cases, false-negative or false-positive results may occur. The depth of coverage may be variable for some target regions; assay performance below the minimum acceptable criteria or for failed regions will be noted. Given these limitations, negative results do not rule out the diagnosis of a genetic disorder. If a specific clinical disorder is suspected, evaluation by alternative methods can be considered.

There may be regions of genes that cannot be effectively evaluated by sequencing or deletion and duplication analysis as a result of technical limitations of the assay, including regions of homology, high guanine-cytosine (GC) content, and repetitive sequences. Confirmation of select reportable variants will be performed by alternate methodologies based on internal laboratory criteria.

This test is validated to detect 95% of deletions up to 75 base pairs (bp) and insertions up to 47 bp. Insertions/deletions (indels) of 40 or more bp, including mobile element insertions, may be less reliably detected than smaller indels.

#### Deletion/Duplication Analysis:

This analysis targets single and multi-exon deletions/duplications; however, in some instances single exon resolution cannot be achieved due to isolated reduction in sequence coverage or inherent genomic complexity. Balanced structural rearrangements (such as translocations and inversions) may not be detected.

This test is not designed to detect low levels of mosaicism or to differentiate between somatic and germline variants. If there is a possibility that any detected variant is somatic, additional testing may be necessary to clarify the significance of results.

Genes may be added or removed based on updated clinical relevance. Refer to the [Targeted Genes and Methodology Details for Congenital Lactic Acidosis Panel](#) in Special Instructions for the most up to date list of genes included in this test. For detailed information regarding gene specific performance and technical limitations, see Method Description or contact a laboratory genetic counselor.

If the patient has had an allogeneic hematopoietic stem cell transplant or a recent heterologous blood transfusion, results may be inaccurate due to the presence of donor DNA. Call Mayo Clinic Laboratories for instructions for testing patients who have received a bone marrow transplant.

#### Reclassification of Variants:

At this time, it is not standard practice for the laboratory to systematically review previously classified variants on a regular basis. The laboratory encourages health care providers to contact the laboratory at any time to learn how the

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classification of a particular variant may have changed over time.

#### Variant Evaluation:

Evaluation and categorization of variants is performed using published American College of Medical Genetics and Genomics and the Association for Molecular Pathology recommendations as a guideline. Other gene-specific guidelines may also be considered. Variants are classified based on known, predicted, or possible pathogenicity and reported with interpretive comments detailing their potential or known significance. Variants classified as benign or likely benign are not reported.

Multiple in silico evaluation tools may be used to assist in the interpretation of these results. The accuracy of predictions made by in silico evaluation tools is highly dependent upon the data available for a given gene, and periodic updates to these tools may cause predictions to change over time. Results from in silico evaluation tools should be interpreted with caution and professional clinical judgement.

#### Clinical Reference

1. Richards S, Aziz N, Bale 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):405-424
2. Bravo-Alonso I, Navarrette R, Vega AI, et al: Genes and variants underlying human congenital lactic acidosis-from genetics to personalized treatment. *J Clin Med.* 2019;8(11):1811

## Performance

#### PDF Report

Supplemental

#### Day(s) Performed

Varies

#### Report Available

28 to 42 days

#### Specimen Retention Time

Whole Blood: 2 weeks (if available); Extracted DNA: 3 months; Blood spots:1 month

#### Performing Laboratory Location

Rochester

## Fees & Codes

#### Fees

- Authorized users can sign in to [Test Prices](#) for detailed fee information.

- Clients without access to Test Prices can contact [Customer Service](#) 24 hours a day, seven days a week.
- Prospective clients should contact their account representative. For assistance, contact [Customer Service](#).

### Test Classification

This test was developed and its performance characteristics determined by Mayo Clinic in a manner consistent with CLIA requirements. It has not been cleared or approved by the US Food and Drug Administration.

### CPT Code Information

- 81443
- 81460
- 81465
- 88233-Tissue culture, skin, solid tissue biopsy (if appropriate)
- 88240-Cryopreservation (if appropriate)
- 81479 (if appropriate for government payers)

### LOINC® Information

Test ID	Test Order Name	Order LOINC® Value
CLADP	Congenital Lactic Acidosis Panel	105352-9

Result ID	Test Result Name	Result LOINC® Value
608632	Test Description	62364-5
608633	Specimen	31208-2
608634	Source	31208-2
608635	Result Summary	50397-9
608636	Result	82939-0
608637	Interpretation	69047-9
608638	Resources	99622-3
608639	Additional Information	48767-8
608640	Method	85069-3
608641	Genes Analyzed	48018-6
608642	Disclaimer	62364-5
608643	Released By	18771-6