MAYO CLINIC LABORATORIES

Test Definition: MSDBS

Multiple Sulfatase Deficiency, Blood Spot

Overview

Useful For

Supporting the biochemical diagnosis of multiple sulfatase deficiency

This test is **not useful for** carrier detection.

Reflex Tests

Test Id	Reporting Name	Available Separately	Always Performed
MPSBS	Mucopolysaccharidosis, BS	Yes	No

Genetics Test Information

This test is a screening panel for individuals with clinical signs and symptoms suspicious for multiple sulfatase deficiency. If an enzyme deficiency is detected by this screening test, additional biochemical or molecular testing is required to confirm a diagnosis.

Testing Algorithm

If results are normal, testing is complete.

If results indicate multiple sulfatase deficiency, quantitation of heparan sulfate, dermatan sulfate and keratan sulfate may be performed at an additional charge.

Special Instructions

- Informed Consent for Genetic Testing
- Biochemical Genetics Patient Information
- Blood Spot Collection Card-Spanish Instructions
- Blood Spot Collection Card-Chinese Instructions
- Informed Consent for Genetic Testing (Spanish)
- Blood Spot Collection Instructions

Method Name

Liquid Chromatography Tandem Mass Spectrometry (LC-MS/MS)

NY State Available

Yes

Specimen

Specimen Type

Whole blood

Necessary Information

1. Patient's age is required.

2. Reason for testing is required.

Specimen Required

Submit only 1 of the following specimen types:

Preferred:

Specimen Type: Blood spot

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

Container/Tube:

Preferred: Blood Spot Collection Card

Acceptable: Whatman Protein Saver 903 Paper, PerkinElmer 226 filter paper, Munktell filter paper, or blood collected in tubes containing ACD or EDTA and dried on filter paper.

Specimen Volume: 2 Blood spots

Collection Instructions:

1. An alternative blood collection option for a patient 1 year of age or older is a fingerstick. For detailed instructions, see How to Collect a Dried Blood Spot Sample.
2. At least 2 spots should be complete (ie, unpunched).
3. Let blood dry on filter paper at room temperature in a horizontal position for a minimum of 3 hours.
4. Do not expose specimen to heat or direct sunlight.
5. Do not stack wet specimens.
6. Keep specimen dry.

Specimen Stability Information: Refrigerated (preferred) 60 days/Ambient 7 days/Frozen 60 days

Additional Information:

1. For collection instructions, see Blood Spot Collection Instructions
2. For collection instructions in Spanish, see Blood Spot Collection Card-Spanish Instructions (T777)
3. For collection instructions in Chinese, see Blood Spot Collection Card-Chinese Instructions (T800)

Acceptable:

Specimen Type: Whole Blood

Container/Tube:

Preferred: Lavender top (EDTA)

Acceptable: Yellow top (ACD)

Specimen Volume: 2 mL

Collection Instructions: Send whole blood specimen in original tube**. Do not aliquot.**

Specimen Stability Information: Refrigerate (preferred) 7 days/Ambient 48 hours

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:

-Informed Consent for Genetic Testing (T576)

-Informed Consent for Genetic Testing-Spanish (T826)

2. Biochemical Genetics Patient Information (T602)
3. If not ordering electronically, complete, print, and send a Biochemical Genetics Test Request (T798) with the specimen.

Specimen Minimum Volume

Blood spot: 1; Whole blood: 0.5 mL

Reject Due To

Blood spot specimen that shows serum rings or has multiple layers	Reject
Insufficient specimen	Reject
Unapproved filter papers	Reject

Specimen Stability Information

Specimen Type	Temperature	Time	Special Container
Whole blood	Varies		

Clinical & Interpretive

Clinical Information

Multiple sulfatase deficiency (MSD) is a rare autosomal recessive lysosomal disorder caused by mutations in the sulfatase-modifying factor 1 (SUMF1) gene. SUMF1 encodes for a formylglycine-generating enzyme that performs a critical posttranslational modification necessary for activation of all human sulfatases, including arylsulfatase A and B. The clinical features of MSD encompass symptoms of every single sulfatase deficiency, including metachromatic leukodystrophy (MLD), the mucopolysaccharidoses, X-linked ichthyosis, and chondrodysplasia punctata type I. Age of onset and clinical severity are variable and correspond with the level of residual enzyme activity. A severe neonatal form of MSD closely overlaps the clinical presentation of the mucopolysaccharidoses, but it is often fatal within 1 year. Late-infantile MSD (onset 0-2 years) accounts for most cases and is characterized by a clinical presentation similar to MLD.

A diagnostic workup for MSD demonstrates reduced enzyme activity of several sulfatase enzymes including those on this panel (iduronate-2-sulfatase, heparan sulfate sulfatase, galactosamine-6-sulfate sulfatase, and arylsulfatase B). Individuals with MSD typically have an increased urinary excretion of sulfatides as well as increased urinary glycosaminoglycans, therefore a combined analysis of urine ceramide trihexoside, mucopolysaccharides, oligosaccharides, and sulfatides (LSDS / Lysosomal Disorders Screen, Random, Urine) may support a diagnosis. Molecular genetic analysis of the *SUMF1* gene (CGPH / Custom Gene Panel, Hereditary, Next-Generation Sequencing, Varies; specify Gene List ID: IEMCP-PCUBX1) allows for detection of disease-causing variants in affected patients and subsequent carrier detection in relatives.

Reference Values

Iduronate-2-sulfatase: >4.30 nmol/mL/h
Heparan-N-sulfatase: >0.06 nmol/mL/h
N-acetylgalactosamine-6-sulfatase: >0.70 nmol/mL/h

An interpretive report will be provided.

Interpretation

Abnormal results are not sufficient to establish a diagnosis of a particular disease. To verify a preliminary diagnosis based on this assay, additional biochemical or molecular genetic analyses are required.

When abnormal results are detected, a detailed interpretation is given, including an overview of the results and of their significance, a correlation to available clinical information, elements of differential diagnosis, recommendations for additional biochemical testing, and in vitro, confirmatory studies (enzyme assay, molecular genetic analysis), and a phone number to reach one of the laboratory directors in case the referring physician has additional questions.

Cautions

Individuals with pseudodeficiency alleles can show reduced enzyme activity.

Carrier status (heterozygosity) for these conditions cannot be reliably detected.

Clinical Reference

1. Neufeld EF, Muenzer J. The mucopolysaccharidoses. In: Valle DL, Antonarakis S, Ballabio A, Beaudet AL, Mitchell GA, eds. The Online Metabolic and Molecular Bases of Inherited Disease. McGraw-Hill; September 11, 2025. https://ommbid.mhmedical.com/content.aspx?bookid=2709&sectionid=225544161
2. Hopwood JJ, Ballabio A. Multiple sulfatase deficiency and the nature of the sulfatase family. In: Valle DL, Antonarakis S, Ballabio A, Beaudet AL, Mitchell GA, eds. The Online Metabolic and Molecular Bases of Inherited Disease. McGraw-Hill; September 11, 2025. https://ommbid.mhmedical.com/content.aspx?bookid=2709&sectionid=225546905
3. Schlotawa L, Adang LA, Radhakrishnan K, Ahrens-Nicklas RC. Multiple sulfatase deficiency: a disease comprising mucopolysaccharidosis, sphingolipidosis, and more caused by a defect in posttranslational modification. Int J Mol Sci. 2020;21(10):3448. doi:10.3390/ijms21103448

Performance

Method Description

One dried blood spot sample (DBS) is incubated with a mix of substrate and internal standard (IS) for iduronate 2-sulfatase, heparan N-sulfatase, alpha-N-acetylglucosaminidase, N-acetylgalactosamine-sulfate, beta-galactosidase, arylsulfatase B, beta-glucuronidase, and tripeptidyl peptidase 1. A second DBS sample is incubated with a mix of substrate and IS for acetyl-CoA:alpha-glucosaminide N-acetyltransferase; and a third DBS sample with a mix of substrate and IS for palmitoyl-protein thioesterase 1. Following overnight incubation, the samples are combined, extracted by liquid-liquid extraction, and analyzed by tandem mass spectrometry.(Unpublished Mayo method)

PDF Report

No

Day(s) Performed
Thursday

Report Available
3 to 9 days

Specimen Retention Time
1 year

Performing Laboratory Location
Mayo Clinic Laboratories - Rochester Main Campus

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
82657
83864 (if appropriate)

LOINC® Information

Test ID	Test Order Name	Order LOINC® Value
MSDBS	Multiple sulfatase deficiency, BS	104116-9

Result ID	Test Result Name	Result LOINC® Value
BG755	Reason for Referral	42349-1
618430	Iduronate-2-sulfatase	79462-8
618431	Heparan-N-sulfatase	104113-6
618432	N-acetylgalactosamine-6-sulfatase	88019-5
618433	Interpretation	59462-2
618429	Reviewed By	18771-6