Cutis Laxa
Indication-Specific Gene Panel

including: sequencing and high resolution deletion/duplication analysis

PANEL DESCRIPTION:
Cutis laxa is a family of conditions characterized as connective tissue disorders. There are many subtypes of cutis laxa, which vary in phenotypic presentation. Features include inelastic skin which sags and may be wrinkly, high myopia, arterial tortuosity, aneurysms, stenosis, joint laxity and arachnodactyly among other clinical features. This indication-specific panel includes 10 genes associated with connective tissue disorders and is designed to detect both sequence-based mutations and small-scale deletions or duplications in these genes of interest.

PANEL DETAILS:
- This panel includes both sequencing and high resolution deletion/duplication analysis of the genes specified.
  - Sequencing is performed using a customized next generation sequencing library. Analysis includes the coding exons of all genes in the panel plus ten bases into the introns and untranslated regions (5’ and 3’). Sanger sequencing is performed to confirm variants suspected or confirmed to be pathogenic.
  - Deletion/duplication analysis is performed using a high resolution, custom microarray platform designed to target the genes of interest at the exon level.
- Detection rates are limited to the genes specified; this test does not provide whole genome analysis.
- Gene panels are a more cost-effective approach than single gene testing to confirm or establish a diagnosis. However, if single gene testing is desired for the patient or family members of an individual with a known mutation, that must be ordered separately.

RECOMMENDED TESTING STRATEGY:
Tests below can be ordered individually, however our laboratory’s recommended Comprehensive Testing for cutis laxa includes the following two tests:

Next Generation Sequencing
- Next generation sequencing (NGS) analyzes multiple genes at once, making this a cost-effective method of testing genes known to be associated with the indications included in this panel.

Targeted Deletion/Duplication Analysis
- If no pathogenic aberrations are detected by NGS, deletion/duplication analysis is performed to identify partial or whole gene deletions and duplications in the associated genes.

DISORDERS INCLUDED IN THIS PANEL:
- Cutis laxa, autosomal dominant [ELN]
- Cutis laxa, autosomal recessive type IA; cutis laxa, autosomal dominant 2 [FBLNS] - GeneReviews®
- Cutis laxa, autosomal dominant 3 [ALDH1B1A1]
- Cutis laxa, autosomal recessive type IB [EFEMP2] - GeneReviews®
- Cutis laxa, autosomal recessive, type IC [LTBP4] - GeneReviews®
  http://www.ncbi.nlm.nih.gov/books/NBK343782/
- Cutis laxa type IIA (Debré-type), wrinkly skin syndrome [ATP6VOA2] - GeneReviews®
- Cutis laxa, autosomal recessive, type IIIA [ALDH1B1A1]
- Cutis laxa, autosomal recessive, type IIIB & IIIB [PYCR1]
- Geroderma osteodysplasticum [GORAB]
- Lenz-Majewski hyperostotic dwarfism [PTDSS1]
- Macrocephaly, alopecia, cutis laxa, and scoliosis (MACS syndrome) [RIN2]
INDICATIONS FOR TESTING:
As this condition has phenotypic variability not all indications are applicable to all types of cutis laxa.
- Joint issues: hyperlaxity, contractures
- Skin findings: cutis laxa, sagging, wrinkly, thin abnormal or atrophic scars, poor wound healing, spontaneous bruising
- Ocular findings: ectopia lentis, myopia, retinal detachment
- Cardiac findings: congenital heart defect, aortic root enlargement, thoracic aneurysm, aortic dissection, other aneurysms/dissections, extra-aortic vascular events, arterial tortuosity
- Pectus excavatum
- Bone findings: fragility
- Respiratory findings: pulmonary emphysema at an early age
- Characteristic facial features: midface retrusion, retrognathia, widely spaced eyes, high palate
- Developmental delay

SPECIMEN COLLECTION & TRANSPORT:
Complimentary test kits are available upon request, but are not required.

SAMPLE TYPE and REQUIREMENTS:
- **blood**: 2-5 ml whole blood in an EDTA tube (purple top)
  - newborn minimum requirement: 1-3 ml
- **buccal swab**: 5 swabs
- **extracted DNA**: 70 ng/µg with a total yield of 7-10 µg (in TE) in a DNA microcentrifuge tube
  * When submitting extracted DNA for genetic testing, nucleic isolation must have occurred in a CLIA-certified laboratory or a laboratory meeting equivalent requirements as determined by the CAP and/or CMS.

SHIPPING:
- Maintain and ship samples at room temperature.
- Coordinate transport for sample to be received in our laboratory within 24-48 hours of collection.
  - **LOCAL**: Call 402-559-5070 (option 1)
  - **OUT OF AREA**: Prior to shipment, please fax the completed test request form to 402-559-7248, including the FedEx® airbill tracking number.
    - Saturday delivery MUST be checked when sending FedEx® on Friday.
    - Please include Internal Billing Reference # 3155070600 on the FedEx® airbill.
    - **Ship To**: Human Genetics Laboratory – Zip 5440
      UNMC Shipping & Receiving Dock
      601 S. Saddle Creek Road
      Omaha, NE 68106

REQUIRED FORM: The following form can be downloaded via our website.
- Postnatal Test Request Form

OPTIONAL FORM:
- Informed Consent for Genetic Testing

POTENTIAL TEST RESULTS:
Once a variant is confirmed, our laboratory team interprets this information in conjunction with the patient’s clinical findings and the scientific literature in order to classify a finding. There are three possible results:
- A **normal** result indicates that sequencing or deletion/duplication analysis of the genes analyzed did not find any pathogenic mutations or variants of uncertain clinical significance (or no clinically-significant chromosome anomalies were identified by microarray analysis).
- An **abnormal (or pathogenic)** result indicates that a pathogenic mutation was identified (or microarray analysis identified a genomic dosage anomaly [deletion or duplication] or ROH that likely provides an explanation for the individual’s clinical findings). Any available information regarding the phenotype associated with that mutation will accompany the technical details on the report.
• In some cases, the clinical significance of an identified sequence variant (or chromosomal anomaly detected by microarray) may not be well understood. These variants (anomalies) will be reported as **variants of uncertain clinical significance (UCS)**. Any available information about the molecular characteristics of the genetic change and the relationship of the genetic change to phenotype will be included on the report. Over time, as more patients are reported, a variant of uncertain clinical significance may be revised to an informative result, and a revised report will be generated.

• Parental testing may be recommended in order to classify the result as *de novo* or familial for the purpose of recurrence risk calculation.

**TURN-AROUND-TIMES:** For all sample types, results are typically available in 4-5 weeks.

**BILLING:** Our laboratory offers patient/self-pay, insurance (including Medicare/Medicaid), and client/institution billing options. Verifying coverage requirements or obtaining preauthorization PRIOR TO OR AT THE TIME OF SPECIMEN COLLECTION is often necessary. We provide preauthorization services upon request by calling 402-559-5070 (option 3); the following form is helpful for obtaining the information required by insurance providers and can be downloaded via our website.

• Insurance Preauthorization Request

In some circumstances, a test may be warranted even though insurance coverage is denied or not guaranteed. For these situations, we request the following form be signed by the patient and submitted with the sample. This helps inform patients of their potential financial responsibility, should the costs of genetic testing not be paid by their insurance provider.

• Advanced Beneficiary Notice of Noncoverage (ABN) – required when billing Medicare

**CPT CODES:**

• Next Generation Sequencing: 81407
• Targeted Deletion/Duplication Analysis: 81228

**PRICING:** For current costs contact the laboratory billing staff at 402-559-5070 (option 3).

**GENE LIST:** *(version 2_10)*

This 10 gene panel is applied to all testing performed on and after April 9, 2018.

<table>
<thead>
<tr>
<th>ALDH18A1</th>
<th>ELN</th>
<th>LTBP4</th>
<th>RIN2</th>
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<tbody>
<tr>
<td>ATP6V0A2</td>
<td>FBLN5</td>
<td>PTDSS1</td>
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PANEL OVERLAP: These genes are also included in the Connective Tissue Disorders panel.

updated 4-9-2018