3-M Syndrome / Primordial Dwarfism Panel

Test code: MA2401

The Blueprint Genetics 3-M Syndrome / Primordial Dwarfism Panel is a 15 gene test for genetic diagnostics of patients with clinical suspicion of 3-M syndrome, Jawad syndrome, Meier-Gorlin syndrome, microcephalic primordial dwarfism disorders (mopd), Seckel syndrome or short stature-onychodysplasia-facial dysmorphism-hypotrichosis syndrome.

Numerous monogenic causes of growth disorders have been identified. Inheritance of most disorders covered by this panel is autosomal recessive, but familial cutaneous telangiectasia and oropharyngeal predisposition cancer syndrome is considered to have autosomal dominant inheritance. This panel covers, but is not limited to, genes and disorders covered by the subpanels, and therefore enables efficient differential diagnostics of primordial dwarfism. This panel includes Meier-Gorlin Syndrome Panel and Seckel Syndrome Panel. This Panel is part of the Comprehensive Short Stature Syndrome Panel and also part of the Comprehensive Skeletal / Malformation Syndrome Panel.

About 3-M Syndrome / Primordial Dwarfism

The clinical phenotypes of the disorders covered by this panel range in the severity of growth retardation and microcephaly, as well as in the degree of developmental delay, but there can be significant clinical overlap among syndromes. Intellect is intact in most cases of MOPD II and Meier-Gorlin syndrome, whereas Seckel syndrome is classically characterized by substantial developmental delay. The genetic bases of many of these disorders have been elucidated recently, and the affected genes have been shown to be vital for fundamental biological processes, such as DNA replication and damage repair. Microcephalic primordial dwarfism constitutes a group of disorders characterized by severe pre- and postnatal growth retardation accompanied by microcephaly. These disorders include MOPD I (Taybi-Linder syndrome), II and III, various types of Seckel syndrome and Meier-Gorlin syndrome. Altogether 150 published cases of type I, II and III MOPD have been reported in the literature. 3-M syndrome is characterized by prenatal growth restriction in the absence of recognizable maternal or placental pathology and by the failure of postnatal catch-up growth resulting in significant proportionate short stature. It is estimated that 77.5% of 3-M syndrome is attributed to mutations in the CUL7 gene and 16% to mutations in OBSL1 gene. The prevalence of 3-M syndrome is unknown; approximately 100 affected individuals have been reported in the literature, but the syndrome has been suggested to be likely underdiagnosed. Dolichospondyllic dysplasia is probably the same as 3-M syndrome. The syndrome is associated with distinct facial features (triangular face, flat maxillae, and prominent forehead), radiological abnormalities (tall vertebrae, slender long bones), and normal intelligence. Final adult height is in the range of 115 to 150 cm.

Availability

Results in 3-4 weeks. We do not offer a maternal cell contamination (MCC) test at the moment. We offer prenatal testing only for cases where the maternal cell contamination studies (MCC) are done by a local genetic laboratory. Read more: http://blueprintgenetics.com/faqs/#prenatal

Gene set description

<table>
<thead>
<tr>
<th>Gene</th>
<th>Associated phenotypes</th>
<th>Inheritance</th>
<th>ClinVar</th>
<th>HGMD</th>
</tr>
</thead>
<tbody>
<tr>
<td>ATR</td>
<td>Cutaneous telangiectasia and cancer syndrome, Seckel syndrome</td>
<td>AD/AR</td>
<td>6</td>
<td>13</td>
</tr>
<tr>
<td>CDC6</td>
<td>Meier-Gorlin syndrome (Ear-patella-short stature syndrome)</td>
<td>AR</td>
<td>1</td>
<td>3</td>
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<tr>
<td>CDT1</td>
<td>Meier-Gorlin syndrome (Ear-patella-short stature syndrome)</td>
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<td>8</td>
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<tr>
<td>CENPJ</td>
<td>Seckel syndrome, Microcephaly</td>
<td>AR</td>
<td>23</td>
<td>6</td>
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<td>CEP63</td>
<td>Seckel syndrome</td>
<td>AR</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>CEP152</td>
<td>Seckel syndrome, Microcephaly</td>
<td>AR</td>
<td>13</td>
<td>17</td>
</tr>
</tbody>
</table>
### Non-coding disease causing variants covered by the panel

<table>
<thead>
<tr>
<th>Gene</th>
<th>Genomic location HG19</th>
<th>HGVS</th>
<th>RefSeq</th>
<th>RS-number</th>
<th>Comment</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>RBBP8</td>
<td>Chr18:20581745</td>
<td>c.2287+53T&gt;G</td>
<td>NM_002894.2</td>
<td></td>
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</tr>
</tbody>
</table>

### Test performance

Blueprint Genetics offers a comprehensive 3-M Syndrome / Primordial Dwarfism Panel that covers classical genes associated with 3-M syndrome, Jawad syndrome, meier-Gorlin syndrome (Ear-patella-short stature syndrome), microcephalic primordial dwarfism disorders (mopd), Seckel syndrome and short stature-onychodysplasia-facial dysmorphism-hypotrichosis syndrome. The genes are carefully selected based on the existing scientific evidence, our experience and most current mutation databases. Candidate genes are excluded from this first-line diagnostic test. The test does not recognise balanced translocations or complex inversions, and it may not detect low-level mosaicism. The test should not be used for analysis of sequence repeats or for diagnosis of disorders caused by mutations in the mitochondrial DNA.

Analytical validation is a continuous process at Blueprint Genetics. Our mission is to improve the quality of the sequencing process and each modification is followed by our standardized validation process. Average sensitivity and specificity in Blueprint NGS Panels is 99.3% and 99.9% for detecting SNPs. Sensitivity to for indels vary depending on the size of the alteration: 1-10bps (96.0%), 11-20 bps (88.4%) and 21-30 bps (66.7%). The longest detected indel was 46 bps by sequence analysis. Detection limit for Del/Dup (CNV) analysis varies through the genome depending on exon size, sequencing coverage and sequence content. The sensitivity is 71.5% for single exon deletions and duplications and 99% for three exons’ deletions and duplications. We have validated the assays for different starting materials including EDTA-blood, isolated DNA (no FFPE) and saliva that all provide high-quality results. The diagnostic yield varies substantially depending on the used assay, referring healthcare professional, hospital and country. Blueprint Genetics’ Plus Analysis (Seq+Del/Dup) maximizes the chance to find molecular genetic diagnosis for your patient although Sequence Analysis or Del/Dup Analysis may be cost-effective first line test if your patient’s phenotype is suggestive for a specific mutation profile.
Bioinformatics

The sequencing data generated in our laboratory is analyzed with our proprietary data analysis and annotation pipeline, integrating state-of-the-art algorithms and industry-standard software solutions. Incorporation of rigorous quality control steps throughout the workflow of the pipeline ensures the consistency, validity and accuracy of results. The highest relevance in the reported variants is achieved through elimination of false positive findings based on variability data for thousands of publicly available human reference sequences and validation against our in-house curated mutation database as well as the most current and relevant human mutation databases. Reference databases currently used are the 1000 Genomes Project (http://www.1000genomes.org), the NHLBI GO Exome Sequencing Project (ESP; http://evs.gs.washington.edu/EVS), the Exome Aggregation Consortium (ExAC; http://exac.broadinstitute.org), ClinVar database of genotype-phenotype associations (http://www.ncbi.nlm.nih.gov/clinvar) and the Human Gene Mutation Database (http://www.hgmd.cf.ac.uk). The consequence of variants in coding and splice regions are estimated using the following in silico variant prediction tools: SIFT (http://sift.jcvi.org), Polyphen (http://genetics.bwh.harvard.edu/pph2/), and Mutation Taster (http://www.mutationtaster.org).

Through our online ordering and statement reporting system, Nucleus, the customer can access specific details of the analysis of the patient. This includes coverage and quality specifications and other relevant information on the analysis. This represents our mission to build fully transparent diagnostics where the customer gains easy access to crucial details of the analysis process.

Clinical interpretation

In addition to our cutting-edge patented sequencing technology and proprietary bioinformatics pipeline, we also provide the customers with the best-informed clinical report on the market. Clinical interpretation requires fundamental clinical and genetic understanding. At Blueprint Genetics our geneticists and clinicians, who together evaluate the results from the sequence analysis pipeline in the context of phenotype information provided in the requisition form, prepare the clinical statement. Our goal is to provide clinically meaningful statements that are understandable for all medical professionals, even without training in genetics.

Variants reported in the statement are always classified using the Blueprint Genetics Variant Classification Scheme modified from the ACMG guidelines (Richards et al. 2015), which has been developed by evaluating existing literature, databases and with thousands of clinical cases analyzed in our laboratory. Variant classification forms the cornerstone of clinical interpretation and following patient management decisions. Our statement also includes allele frequencies in reference populations and in silico predictions. We also provide PubMed IDs to the articles or submission numbers to public databases that have been used in the interpretation of the detected variants. In our conclusion, we summarize all the existing information and provide our rationale for the classification of the variant.

A final component of the analysis is the Sanger confirmation of the variants classified as likely pathogenic or pathogenic. This does not only bring confidence to the results obtained by our NGS solution but establishes the mutation specific test for family members. Sanger sequencing is also used occasionally with other variants reported in the statement. In the case of variant of uncertain significance (VUS) we do not recommend risk stratification based on the genetic finding. Furthermore, in the case VUS we do not recommend use of genetic information in patient management or genetic counseling. For some cases Blueprint Genetics offers a special free of charge service to investigate the role of identified VUS.

We constantly follow genetic literature adapting new relevant information and findings to our diagnostics. Relevant novel discoveries can be rapidly translated and adopted into our diagnostics without delay. These processes ensure that our diagnostic panels and clinical statements remain the most up-to-date on the market.

CPT codes

SEQ 81479
DEL/DUP 81479

https://blueprintgenetics.com/
ICD codes

Commonly used ICD-10 codes when ordering the 3-M Syndrome / Primordial Dwarfism Panel

<table>
<thead>
<tr>
<th>ICD-10</th>
<th>Disease</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q87.1</td>
<td>3-M syndrome</td>
</tr>
<tr>
<td>Q87.1</td>
<td>Microcephalic primordial dwarfism disorders (mopd)</td>
</tr>
<tr>
<td>Q87.1</td>
<td>Seckel syndrome</td>
</tr>
<tr>
<td>Q87.1</td>
<td>Meier-Gorlin syndrome (Ear-patella-short stature syndrome)</td>
</tr>
<tr>
<td>Q87.1</td>
<td>Jawad syndrome</td>
</tr>
<tr>
<td>Q87.1</td>
<td>Short stature-onychodysplasia-facial dysmorphism-hypotrichosis syndrome</td>
</tr>
</tbody>
</table>

Accepted sample types

- EDTA blood, min. 1 ml
- Purified DNA, min. 5μg
- Saliva (Oragene DNA OG-500 kit)

Label the sample tube with your patient’s name, date of birth and the date of sample collection.

Note that we do not accept DNA samples isolated from formalin-fixed paraffin-embedded (FFPE) tissue.

Resources

- Rinnekoti-Säätiö - 3M-oireyhtymä
- Lyhytkavuiset Ry
- Walking With Giants Foundation Meier-Gorlin Syndrome
- Rinnekoti-Säätiö - Jawad-oireyhtymä
- NORD - 3M Syndrome
- NORD - Seckel Syndrome
- NORD - Meier-Gorlin Syndrome
- Gene Reviews - 3M Syndrome
- Gene Reviews - Microcephalies and Seckel Syndrome
- Gene Reviews - Seckel Syndrome