

# Acute Lymphoblastic Leukemia FISH Panels

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Acute lymphoblastic leukemia (ALL) is an aggressive leukemia of B- or T-lineage immature lymphoid cells. B-cell ALL (B-ALL) is primarily a disease of early childhood. Fluorescence in situ hybridization (FISH) testing identifies rearrangements in specific genes used in risk stratification and treatment decisions for children and adults newly diagnosed with B-ALL.

## Disease Overview

### Incidence

B-ALL occurs in 1.6/100,000 individuals per year, and is the most common leukemia in childhood.<sup>1</sup>

### Symptoms

Bone marrow failure (e.g., anemia, thrombocytopenia, leukopenia) and constitutional symptoms (e.g., fever, lethargy, weight loss) are common.<sup>2</sup> In children, joint or extremity pain may be the only presenting symptom.<sup>3,4</sup>

### Genetics

Pediatric ALL	Adult ALL	Ph-Like ALL
<i>BCR-ABL1</i>	<i>BCR-ABL1</i>	<i>CRLF2</i>
<i>KMT2A (MLL)</i>	<i>KMT2A (MLL)</i>	<i>JAK2</i>
<i>ETV6-RUNX1</i>	<i>TCF3 (E2A)</i>	<i>EPOR</i>
<i>CEP4</i>	<i>IGH</i>	<i>CSF1R</i>
<i>CEP10</i>	<i>MYC</i>	<i>ABL1</i>
		<i>ABL2</i>
		<i>PDGFRB</i>

Ph, Philadelphia chromosome

## Test Interpretation

### Test Results

#### Pediatric FISH

- Normal: no evidence of *BCR-ABL1* t(9;22), *KMT2A* (MLL) rearrangement, *ETV6-RUNX1* t(12;21), *RUNX1* amplification or copy number gain with *CEP4* and/or *CEP10*
- Abnormal: one of the above rearrangements or translocations detected

### Featured ARUP Testing

#### [Acute Lymphoblastic Leukemia \(ALL\) Panel by FISH, Adult 2002647](#)

**Method:** Fluorescence in situ Hybridization (FISH)

- Recommended FISH panel for adults with newly diagnosed B-ALL
- Probes include *BCR-ABL1* t(9;22), *KMT2A* (MLL) 11q23 rearrangement (partner not determined), *TCF3* (E2A) rearrangement (partner not determined), *IGH* rearrangement (partner not determined), *MYC* rearrangement

#### [Acute Lymphoblastic Leukemia \(ALL\) Panel by FISH, Pediatric 2002719](#)

**Method:** Fluorescence in situ Hybridization (FISH)

- Recommended FISH panel for children with newly diagnosed B-ALL
- Probes include *BCR-ABL1* t(9;22), *KMT2A* (MLL) 11q23 rearrangement (partner not determined), *ETV6-RUNX1*, t(12;21), *CEP4*, *CEP10*

#### [Ph-Like Acute Lymphoblastic Leukemia \(ALL\) Panel by FISH 3000455](#)

**Method:** Fluorescence in situ Hybridization (FISH)

- Diagnosis, prognosis, and monitoring of *BCR-ABL1*-like B-ALL
- Probes include *CRLF2* rearrangement, *JAK2* rearrangement, *EPOR* rearrangement, *CSF1R* rearrangement, *ABL1* rearrangement, *ABL2* rearrangement, *PDGFRB* rearrangement
- Order when other major prognostic markers (e.g., *BCR-ABL1*, *ETV6-RUNX1*) are negative

#### Testing Strategy

At diagnosis, the minimum ALL workup includes bone marrow aspirate for morphology, immunophenotyping, cytogenetics (e.g., karyotyping and fluorescence in situ hybridization [FISH]), and other molecular testing, as indicated.

## Adult FISH

- Normal: no evidence of *BCR-ABL1* t(9;22), *KMT2A* (*MLL*) rearrangement, *TCF3* (*E2A*) rearrangement, *IGH* rearrangement, or *MYC* rearrangement
- Abnormal: one of the above rearrangements/translocations or copy number change detected

## Ph-Like ALL FISH

- Normal: no evidence of rearrangement involving *CRLF2*, *JAK2*, *EPOR*, *CSF1R*, *ABL1*, *ABL2*, or *PDGFRB*
- Abnormal: one of the described rearrangements detected

## Prognostic Issues

More information on the prognostic significance of identified genetic rearrangements can be found in the ARUP Consult [Acute Lymphoblastic Leukemia](#) topic.

## Limitations

Panels detect only the specific aberrations targeted by the FISH probes included. Chromosome alterations outside the regions complementary to these probes will not be detected.

## References

1. American Cancer Society. [Key statistics for acute lymphocytic leukemia](#). Last revised Jan 2020; accessed Jul 2020.
2. Terwilliger T, Abdul-Hay M. [Acute lymphoblastic leukemia: a comprehensive review and 2017 update](#). *Blood Cancer J.* 2017;7(6):e577.
3. National Comprehensive Cancer Network. [NCCN Clinical Practice Guidelines in Oncology: Acute lymphoblastic leukemia](#). Version 2.2019. Accessed Oct 2019.
4. Paul S, Kantarjian H, Jabbour EJ. [Adult acute lymphoblastic leukemia](#). *Mayo Clin Proc.* 2016;91(11):1645-1666.

## Related Information

Acute Lymphoblastic Leukemia - ALL  
BCR-ABL1 (BCR::ABL1) Qualitative and Quantitative Testing  
Cytogenomic Microarray, Oncology  
Leukemia/Lymphoma Phenotyping Evaluation by Flow Cytometry  
TPMT and NUDT15

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