

## Overview

### Useful For

Diagnostic workup of patients with high probability of *BCR-ABL1*-positive hematopoietic neoplasms, predominantly chronic myeloid/myelogenous leukemia and acute lymphoblastic leukemia

### Reflex Tests

Test Id	Reporting Name	Available Separately	Always Performed
B190R	BCR/ABL1, p190, Quant, Reflex	Yes, (order BA190), Bill only	No
B210R	BCR/ABL1, p210, Quant, Reflex	Yes, (order BCRA), Bill only	No

### Testing Algorithm

When a positive common p210 or p190 *BCR/ABL1* result is identified by the qualitative assay, a reflex test will then be performed at an additional charge to determine the quantitative transcript level of *BCR/ABL1* messenger RNA. A positive common p210 or p190 result will specifically trigger either quantitative p210 or p190 testing to provide a normalized percentage of transcript level. For the p210 target, the value is additionally defined using the International Scale (IS) convention. The results are released in an integrated report and provide a baseline quantitative transcript to monitor treatment response. If the initial qualitative testing is negative, or an alternate rare form of *BCR/ABL1* is detected, then no reflex testing will be pursued, and the initial results will be reported.

The following documents are available:

- [-Myeloproliferative Neoplasm: A Diagnostic Approach to Bone Marrow Evaluation](#)
- [-Myeloproliferative Neoplasm: A Diagnostic Approach to Peripheral Blood Evaluation](#)

### Special Instructions

- [Myeloproliferative Neoplasm: A Diagnostic Approach to Peripheral Blood Evaluation](#)
- [Myeloproliferative Neoplasm: A Diagnostic Approach to Bone Marrow Evaluation](#)
- [Hematopathology Patient Information](#)
- [BCR/ABL1 Ordering Guide for Blood and Bone Marrow](#)

### Highlights

Following a positive *BCR/ABL1* diagnostic reverse transcription-polymerase chain reaction result, a reflex test will be performed to provide a quantitative measurement of *BCR/ABL1* mRNA transcript (either p190 or p210 types). Current National Comprehensive Cancer Network guidelines for chronic myeloid leukemia, for example, indicate that the quantitative p210 messenger RNA transcript level be obtained at diagnosis. The reflex test establishes the initial patient diagnostic baseline level to assess response to therapy in follow-up samples.

---

**Method Name**

Reverse Transcription-Polymerase Chain Reaction (RT-PCR) Multiplex PCR

**NY State Available**

Yes

**Specimen****Specimen Type**

Varies

**Ordering Guidance**For information on which test to order for various scenarios, see [BCR/ABL1 Ordering Guide for Blood and Bone Marrow](#).**Shipping Instructions****Specimen must arrive within 72 hours of collection.** Collect and package specimen as close to shipping time as possible.**Necessary Information****The following information is required:**

1. Pertinent clinical history including if the patient has a diagnosis of chronic myeloid/myelogenous leukemia or other *BCR/ABL1* positive neoplasm
2. Date of collection
3. Specimen source (blood or bone marrow)

**Specimen Required****Submit only 1 of the following specimens:****Specimen Type:** Whole blood**Container/Tube:****Preferred:** Lavender top (EDTA)**Acceptable:** Yellow top (ACD)**Specimen Volume:** 10 mL**Collection Instructions:**

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

**Specimen Type:** Bone marrow**Container/Tube:****Preferred:** Lavender top (EDTA)**Acceptable:** Yellow top (ACD)

## Test Definition: BCRFX

BCR/ABL1 Qualitative Diagnostic Assay with  
Reflex to BCR/ABL1 p190 Quantitative Assay or  
BCR/ABL1 p210 Quantitative Assay, Varies

**Specimen Volume:** 4 mL

**Collection Instructions:**

1. Invert several times to mix bone marrow.
2. Send bone marrow specimen in original tube. **Do not aliquot.**
3. Label specimen as bone marrow.

**Forms**

1. [Hematopathology Patient Information](#) (T676)
2. If not ordering electronically, complete, print, and send a [Hematopathology/Cytogenetics Test Request](#) (T726) with the specimen.

**Specimen Minimum Volume**

Blood: 8 mL

Bone marrow: 2 mL

**Reject Due To**

Gross hemolysis	Reject
Moderately to severely clotted	Reject

**Specimen Stability Information**

Specimen Type	Temperature	Time	Special Container
Varies	Refrigerated (preferred)	72 hours	PURPLE OR PINK TOP/EDTA
	Ambient	72 hours	PURPLE OR PINK TOP/EDTA

**Clinical & Interpretive**

**Clinical Information**

The t(9;22)/*BCR-ABL1* abnormality is associated with chronic myelogenous leukemia (CML) and "Philadelphia positive" acute lymphoblastic leukemia of B-cell lineage (Ph+ ALL). Very rarely, this abnormality has also been identified in cases of acute myeloid leukemia and T-lymphoblastic leukemia/lymphoma. The fusion gene on the derivative chromosome 22q11 produces a chimeric *BCR-ABL1* messenger RNA (mRNA) transcript and corresponding translated oncoprotein. Despite substantial breakpoint heterogeneity at the DNA level, a consistent set of *BCR-ABL1* mRNA transcripts are produced that can be readily and sensitively detected by reverse transcription polymerase chain reaction (RT-PCR) technique. In CML, breakpoints in *BCR* result in either exons 13 or 14 (e13, e14) joined to exon 2 of *ABL1* (a2). The corresponding e13-a2 or e14-a2 *BCR-ABL1* mRNAs produce a 210 kDa protein (p210). Rare cases of CML are characterized by an e19-a2 type mRNA with a corresponding p230 protein. In Ph+ ALL, the majority of cases harbor an e1-a2 *BCR-ABL1* mRNA transcript, producing a p190 protein. However, chimeric mRNA type is not invariably associated with disease type, as noted by the presence of p210-positive Ph ALL and very rare cases of p190-positive CML. Therefore, positive results from a screening (diagnostic) assay for *BCR-ABL1* mRNA need to be correlated with clinical

---

and pathologic findings.

In addition to the main transcript variants described above, rare occurrences of both CML and Ph+ ALL can have alternative break-fusion events resulting in unusual *BCR-ABL1* transcript types. Examples include e6-a2 and *BCR* exon fusions to *ABL1* exon a3 (eg, e13-a3, e14-a3, or e1-a3). In addition to detecting common *BCR-ABL1* mRNA transcripts, this assay also can identify these rarer *BCR-ABL1* transcript variants and is therefore a comprehensive screen for both usual and uncommon *BCR-ABL1* gene fusions in hematopoietic malignancies. Given the nature of genetic events in tumors however, this assay will not identify extremely rare and unexpected *BCR-ABL1* events involving other exons (eg, case report level) and is therefore not absolutely specific but is predicted to detect greater than 99.5% of *BCR-ABL1* events. Therefore, it is recommended that for diagnosis, RT-PCR plus a second method (eg, *BCR-ABL1* fluorescence in situ hybridization or cytogenetics) should be used. However, this RT-PCR assay is invaluable at diagnosis for identifying the precise *BCR-ABL1* mRNA type (eg, for future quantitative assay disease monitoring), which complementary methods cannot.

This assay is intended as a qualitative method, providing information on the presence (and specific mRNA type) or absence of the *BCR-ABL1* mRNA. Results from this test can be used to determine the correct subsequent assay for monitoring of transcript levels following therapy (eg, BCRA190 / *BCR/ABL1*, p190, mRNA Detection, Reverse Transcription-PCR (RT-PCR), Quantitative, Monitoring Chronic Myeloid Leukemia (CML), Varies; BA190 / *BCR/ABL1*, p190, mRNA Detection, Reverse Transcription-PCR (RT-PCR), Quantitative, Monitoring Assay, Varies). Because the assay is analytically sensitive, it compensates for situations such as partially degraded RNA quality, or low cell number but it is not intended for quantitative or monitoring purposes.

### Reference Values

An interpretive report will be provided.

### Interpretation

An interpretive report will be provided.

When positive, the test identifies which specific messenger RNA fusion variant is present to guide selection of an appropriate monitoring assay. If common p210 or p190 fusion variant detected, quantitative reflex will be performed.

-Common fusion variants detected: e13-a2 or e14-a2 (p210), e1-a2 (p190), and e6-a2 (p205\*)

-Rare fusion variants detected: e13-a3 (p210), e14-a3 (p210), e1-a3 (p190), e19-a2 (p230)

-Potential rare fusions detected: e12-a3, e19-a3

\*This is formerly observed as the e6-a2 (p185) fusion form

### Cautions

No significant cautionary statements

### Clinical Reference

1. Burmeister T, Reinhardt R: A multiplex PCR for improved detection of typical and atypical BCR-ABL fusion transcripts. *Leuk Res.* 2008 Apr;32(4):579-585
2. Melo JV: The diversity of BCR-ABL fusion proteins and their relationship to leukemia phenotype. *Blood.* 1996 Oct 1;88(7):2375-2384

- 
3. Melo JV: BCR-ABL gene variants. *Baillieres Clin Haematol.* 1997 Jun;10(2):203-222
  4. Baccarini M, Deininger MW, Rosti G, et al: European LeukemiaNet recommendations for the management of chronic myeloid leukemia: 2013. *Blood.* 2013 Aug;122(6):872-884
  5. Cross NC, White HE, Muller MC, et al: Standardized definitions of molecular response in chronic myeloid leukemia. *Leukemia.* 2012 Oct;26(10):2172-2175
  6. Deininger MW, Shah NP, Altman JK, et al: Chronic Myeloid Leukemia, Version 2.2021, NCCN Clinical Practice Guidelines in Oncology. *J Natl Compr Canc Netw.* 2020 Oct 1;18(10):1385-1415. doi: 10.6004/jnccn.2020.0047

## Performance

### Method Description

Total RNA is extracted from the patient's blood or bone marrow at the time of diagnosis and messenger RNA (mRNA) is reverse transcribed into complementary DNA (cDNA). The cDNA is then subjected to polymerase chain reaction (PCR) using 4 separate multiplex reactions. A qualitative result, which will include the relative ratio of target translocation mRNA to control *GUSB* gene mRNA, will be given by LightCycler 96 software. As this method employs a quantitative PCR platform, the results can be used to evaluate the relative expression levels of the translocation mRNA relative to control mRNA, thus providing an improved measure of RNA quality in the assay. Reporting of results will be qualitative; either *BCR-ABL1* mRNA positive/detected (with transcript type) or negative/not detected. (Unpublished Mayo method)

### PDF Report

No

### Day(s) Performed

Monday through Friday

### Report Available

7 to 10 days

### Specimen Retention Time

Blood/Bone marrow: 2 weeks; Extracted RNA: 3 months

### 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.

## Test Definition: BCRFX

BCR/ABL1 Qualitative Diagnostic Assay with  
Reflex to BCR/ABL1 p190 Quantitative Assay or  
BCR/ABL1 p210 Quantitative Assay, Varies

- 
- Prospective clients should contact their Regional Manager. 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. This test has not been cleared or approved by the US Food and Drug Administration.

### CPT Code Information

81208

81206

81207

### LOINC® Information

Test ID	Test Order Name	Order LOINC® Value
BCRFX	BCR/ABL1 Reflex, Qual/Quant	In Process

Result ID	Test Result Name	Result LOINC® Value
MP039	Specimen Type	31208-2
48389	BCR/ABL1 Reflex Result	No LOINC Needed
48388	Interpretation	69047-9