



# Louisiana

## JAK2, MPL, and CALR Testing for Myeloproliferative Neoplasms

Policy # 00420

Original Effective Date: 04/23/2014

Current Effective Date: 10/17/2018

*Applies to all products administered or underwritten by Blue Cross and Blue Shield of Louisiana and its subsidiary, HMO Louisiana, Inc. (collectively referred to as the "Company"), unless otherwise provided in the applicable contract. Medical technology is constantly evolving, and we reserve the right to review and update Medical Policy periodically.*

### When Services Are Eligible for Coverage

*Coverage for eligible medical treatments or procedures, drugs, devices or biological products may be provided only if:*

- *Benefits are available in the member's contract/certificate, and*
- *Medical necessity criteria and guidelines are met.*

Based on review of available data, the Company may consider Janus kinase 2 (*JAK2*) testing in the diagnosis of patients presenting with clinical, laboratory, or pathologic findings suggesting polycythemia vera (PV), essential thrombocythemia (ET), or primary myelofibrosis (PMF) to be **eligible for coverage**.

*Note: Based on criteria from the World Health Organization, documentation of a serum erythropoietin level below the reference range for normal is recommended before *JAK2* testing.*

Based on review of available data, the Company may consider MPL and CALR testing in the diagnosis of patients presenting with clinical, laboratory, or pathologic findings suggesting essential thrombocythemia or primary myelofibrosis to be **eligible for coverage**.

### When Services Are Considered Investigational

*Coverage is not available for investigational medical treatments or procedures, drugs, devices or biological products.*

Based on review of available data, the Company considers Janus kinase 2 (*JAK2*), MPL, and CALR testing to be **investigational\*** in all other circumstances including, but not limited to, the following situations:

- Diagnosis of nonclassic forms of myeloproliferative neoplasms (MPNs); or
- Molecular phenotyping of patients with myeloproliferative neoplasms (MPNs); or
- Monitoring, management, or selecting treatment in patients with myeloproliferative neoplasms (MPNs)

### POLICY GUIDELINES

#### TESTING STRATEGY

Patients suspected to have polycythemia vera should first be tested for the most common finding, *JAK2* V617F. If the testing is negative, further testing to detect other *JAK2* tyrosine kinase variants (eg, in exon 12) is warranted.

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Patients suspected to have essential thrombocythemia or primary myelofibrosis should first be tested for *JAK2* variants, as noted. If testing is negative, further testing to detect *MPL* and *CALR* variants is warranted.

### CRITERIA FOR POLYCYTHEMIA TESTING

Based on the World Health Organization (WHO) major and minor criteria (see Table PG1), documentation of serum erythropoietin level below the reference range for normal meets a minor criterion for polycythemia vera. Therefore, serum erythropoietin testing is recommended before *JAK2* testing.

**Table PG1. WHO Diagnostic Criteria for Polycythemia Vera**

Major Criteria	
• Increased hemoglobin level (>16.5 g/dL in men or >16.0 g/dL in women)	
• Increased hematocrit (>49% in men or >48% in women)	
• Other evidence of increased red cell volume	
• Bone marrow biopsy showing hypercellularity for age with trilineage maturation, including prominent erythroid, granulocytic, and megakaryocytic proliferation with pleomorphic, mature megakaryocytes (differences in size)	
• <i>JAK2</i> V617F or <i>JAK2</i> exon 12 variant detected	
Minor Criterion	
Serum erythropoietin level below the reference range for normal	

Adapted from Arber et al (2016).

WHO: World Health Organization.

### GENETICS NOMENCLATURE UPDATE

The Human Genome Variation Society nomenclature is used to report information on variants found in DNA and serves as an international standard in DNA diagnostics. It is being implemented for genetic testing medical evidence review updates starting in 2017 (see Table PG2). The Society's nomenclature is recommended by the Human Variome Project, the HUMAN Genome Organization, and by the Human Genome Variation Society itself.

The American College of Medical Genetics and Genomics and the Association for Molecular Pathology standards and guidelines for interpretation of sequence variants represent expert opinion from both organizations, in addition to the College of American Pathologists. These recommendations primarily apply to genetic tests used in clinical laboratories, including genotyping, single genes, panels, exomes, and genomes. Table PG3 shows the recommended standard terminology—"pathogenic," "likely pathogenic," "uncertain significance," "likely benign," and "benign"—to describe variants identified that cause Mendelian disorders.

**Table PG2. Nomenclature to Report on Variants Found in DNA**

Previous	Updated	Definition
Mutation	Disease-associated variant	Disease-associated change in the DNA sequence
	Variant	Change in the DNA sequence
	Familial variant	Disease-associated variant identified in a proband for use in subsequent targeted

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genetic testing in first-degree relatives

**Table PG3. ACMG-AMP Standards and Guidelines for Variant Classification**

Variant Classification	Definition
Pathogenic	Disease-causing change in the DNA sequence
Likely pathogenic	Likely disease-causing change in the DNA sequence
Variant of uncertain significance	Change in DNA sequence with uncertain effects on disease
Likely benign	Likely benign change in the DNA sequence
Benign	Benign change in the DNA sequence

ACMG: American College of Medical Genetics and Genomics; AMP: Association for Molecular Pathology.

### GENETIC COUNSELING

Experts recommend formal genetic counseling for patients who are at risk for inherited disorders and who wish to undergo genetic testing. Interpreting the results of genetic tests and understanding risk factors can be difficult for some patients; genetic counseling helps individuals understand the impact of genetic testing, including the possible effects the test results could have on the individual or their family members. It should be noted that genetic counseling may alter the utilization of genetic testing substantially and may reduce inappropriate testing; further, genetic counseling should be performed by an individual with experience and expertise in genetic medicine and genetic testing methods.

### Background/Overview

#### MYELOPROLIFERATIVE NEOPLASMS

MPNs are rare overlapping blood diseases characterized by the production of one or more blood cell lines. The most common forms of MPNs include PV, ET, PMF, and chronic myeloid leukemia (CML). A common finding in many MPNs is clonality and a central pathogenic feature the detection of a somatic (acquired) pathogenic variant in disease-associated genes. Pathogenic variants in disease-associated genes result in constitutively activated tyrosine kinase enzyme or cell surface receptor.

#### CML and Philadelphia Chromosome

The paradigm for the use of molecular genetics to revolutionize patient management is CML. A unique chromosomal translocation t(9;22), the Philadelphia chromosome (Ph), leads to a unique gene rearrangement (*BCR-ABL*) creating a fusion gene that encodes for a constitutively active Bcr-abl fusion protein. These findings led to the development of targeted tyrosine kinase inhibitor drug therapy (imatinib) that produces long-lasting remissions. The remainder of this evidence review focuses only on the non-Ph or Ph-negative MPNs with a focus on genetic testing for *JAK2*, *CALR*, and *MPL*.

#### Ph-Negative MPNs

Diagnosis and monitoring of patients with Ph-negative MPNs have been challenging because many of the laboratory and clinical features of the classic forms of these diseases—PV, ET, or PMF—can be mimicked by other conditions such as reactive or secondary erythrocytosis, thrombocytosis, or myeloid fibrosis. Additionally, these entities can be difficult to distinguish on morphologic bone marrow exam, and diagnosis

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can be complicated by changing disease patterns: PV and ET can evolve into PMF or undergo leukemic transformation. World Health Organization criteria were published as a benchmark for diagnosis in 2001 and updated in 2008 and 2016. Applying these criteria have been challenging because they involve complex diagnostic algorithms, rely on morphologic assessment of uncertain consistency, and require tests that are not well-standardized or widely available, such as endogenous erythroid colony formation.

### **Classic Myeloproliferative Neoplasms**

Varying combinations of these criteria are used to determine whether a patient has PV, ET, or PMF, ie, MPNs that are Ph-negative. An important component of the diagnostic process is a clinical and laboratory assessment to rule out reactive or secondary causes of disease.

As noted, some diagnostic methods (eg, bone marrow microscopy) are not well-standardized, and others (eg, endogenous erythroid colony formation) are neither standardized nor widely available.

### **Nonclassic Forms of MPNs**

Although the most common Ph-negative MPNs include what is commonly referred to as classic forms of this disorder (PV, ET, PMF), rare patients may show unusual manifestations of nonclassic forms of MPNs, such as chronic myelomonocytic leukemia, hypereosinophilic syndrome, systemic mastocytosis, chronic neutrophilic leukemia, or others. Reports have identified *JAK2* V617F variants in some of these cases.

### **Molecular Genetics of Ph-Negative MPNs**

#### ***JAK2* Gene**

The *JAK2* gene, located on chromosome 9, contains the genetic code for making the Janus kinase 2 protein, a nonreceptor tyrosine kinase. The JAK2 protein is part of the JAK/STAT signal transduction pathway that is important for the controlled production of blood cells from hematopoietic stem cells. Somatic (acquired) variants in the *JAK2* gene are found in patients with PV (~96%), ET (50%), and PMF (50%).

#### ***JAK2* V617F Variant**

In 2005, 4 separate groups using different modes of discovery and different measurement techniques reported on the presence of a novel somatic (acquired) single nucleotide variant in the conserved autoinhibitory pseudokinase domain of the gene encoding JAK2 protein in patients with classic MPNs. The single nucleotide variant caused a valine-to-phenylalanine substitution at amino acid position 617 (*JAK2* V617F) leading to a novel somatic gain-of-function single nucleotide variant that resulted in the loss of autoinhibition of the JAK2 tyrosine kinase. *JAK2* V617F is a constitutively activated kinase that recruits and phosphorylates substrate molecules including signal transducers and activators of transcript (STAT) proteins (so-called JAK-STAT signaling). The result is cell proliferation independent of normal growth factor control.

The *JAK2* V617F variant was present in blood and bone marrow from a variable portion of patients with classic *BCR-ABL*-negative (ie, Ph-negative) MPNs including 65% to 97% of patients with PV, 23% to 57%

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with ET, and 35% to 56% with PMF (see Table 1). The variant was initially reported to be absent in all normal subjects and patients with secondary erythrocytosis, although very low levels of cells carrying the variant have been reported in a small subset of healthy individuals.

**Table 1. Frequency of the JAK2 V617F Variant in Patients With Classic Philadelphia Chromosome–Negative Myeloproliferative Neoplasm From Case Series**

Study	Variant Detection		PV	ET	PMF	Normals	Secondary Erythrocytosis
	Method						
Baxter et al (2005)	DNA sequencing, PCR		71/73 (97)	29/51 (57)	8/16 (50)	0/90 (0)	NR
Jones et al (2005)	PCR testing		58/72 (81)	24/59 (41)	15/35 (43)	0/160 (0)	0/4 (0)
Levine et al (2005)	DNA sequencing		121/164 (74)	37/115 (32)	16/46 (35)	0/269 (0)	NR
James et al (2005)	DNA sequencing		40/45 (88)	9/21 (43)	3/7 (43)	0/15 (0)	0/35 (0)
Kralovics et al (2005)	DNA sequencing		83/128 (65)	21/94 (23)	13/23 (56)	0/142 (0)	0/11 (0)
Tefferi et al (2005)	PCR testing		36/38 (95)	12/46 (55)	3/10 (30)	NR	0/19 (0)
Zhao et al (2005)	DNA sequencing		20/24 (83)	NR	NR	0/12 (0)	NR
Campbell et al (2005)	PCR testing		NR	414/776 (53)	NR	NR	NR
Wolanskyj et al (2005)	PCR testing		NR	73/150 (49)	NR	NR	NR
Campbell et al (2006)	PCR testing		NR	NR	83/152 (55)	NR	NR
Tefferi et al (2005)	PCR testing		NR	NR	80/157 (51)	NR	NR

Values are n/N (%).

ET: essential thrombocythemia; NR: not reported; PCR: polymerase chain reaction; PMF: primary myelofibrosis; PV: polycythemia vera.

In vivo, mice irradiated and then given transplanted bone marrow cells infected with a retrovirus containing the variant developed a myeloproliferative syndrome.

Although almost all studies were retrospective case series and/or cross-sectional studies, and although both the analytic and clinical performances appeared dependent on the laboratory method used to detect the variant, there has been consistency across studies in demonstrating that the JAK2 V617F variant is a highly specific marker for clonal evidence of an MPN.

### JAK2 Exon 12 Variants

Scott et al (2007) identified 4 somatic gain-of-function variants in JAK2 exon 12 in 10 of 11 PV patients without the JAK2 V617F variant. Patients with a JAK2 exon 12 variant differed from those with the JAK2 V617F variant, presenting at a younger age with higher hemoglobin levels and lower platelet and white cell counts. Erythroid colonies could be grown from their blood samples in the absence of exogenous erythropoietin, and mice treated with transfected bone marrow transplants developed a myeloproliferative syndrome.

Findings have been confirmed by a number of investigators who identified additional variants with similar functional consequences in patients with PV and patients with idiopathic erythrocytosis. Based on these findings, it has been concluded that the identification of JAK2 exon 12 variants provides a diagnostic test for

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*JAK2* V617F–negative patients who present with erythrocytosis. Of note, different variants in the same gene appear to have different effects on signaling, resulting in distinct clinical phenotypes.

### ***CALR* Gene**

The *CALR* gene, located on chromosome 19, contains the genetic code for making the calreticulin protein, a multifunctional protein located in the endoplasmic reticulum, cytoplasm, and cell surface. The calreticulin protein is thought to play a role in cell growth and division and regulation of gene activity. Somatic variants in the *CALR* gene are associated with ET and PMF.

### ***MPL* Gene**

The *MPL* gene, located on chromosome 1, contains the genetic code for making the thrombopoietin receptor, a cell surface protein that stimulates the JAK/STAT signal transduction pathway. The thrombopoietin receptor is critical for the cell growth and division of megakaryocytes, which produce platelets involved in blood clotting. Somatic variants in the *MPL* gene are associated with ET and PMF.

### **Frequency of *JAK2*, *CALR*, and *MPL* Somatic Variants in Ph-Negative MPNs**

Ph-negative MPNs are characterized by their molecular genetic alterations. Table 2 summarizes the driver genes and somatic variants associated with specific Ph-negative MPNs.

**Table 2. Frequency of *JAK2*, *CAL4*, and *MPL* Somatic Variants in Ph-Negative MPNs**

Ph-Negative MPNs	<i>JAK2</i> Somatic Variant Detected, % of Patients	<i>CALR</i> Somatic Variant Detected, % of Patients	<i>MPL</i> Somatic Variant Detected, % of Patients
Polycythemia vera	<ul style="list-style-type: none"> <li>• <i>JAK2</i> V617F, 95</li> <li>• <i>JAK2</i> exon12 variants, 5</li> </ul>		
Essential thrombocythemia	<i>JAK2</i> V617F, 60-65	<i>CALR</i> exon 9 indels, 20-25	<i>MPL</i> exon 10 variants, 5
Primary myelofibrosis	<i>JAK2</i> V617F, 60-65	<i>CALR</i> exon 9 indels, 20-25	<i>MPL</i> exon 10 variants, 5

Adapted from Cazzola et al (2014).

indels: insertions and deletions; MPN: myeloproliferative neoplasm; Ph: Philadelphia chromosome.

### **FDA or Other Governmental Regulatory Approval**

Clinical laboratories may develop and validate tests in-house and market them as a laboratory service; laboratory-developed tests must meet the general regulatory standards of the Clinical Laboratory Improvement Amendments. More than a dozen commercial laboratories currently offer a wide variety of diagnostic procedures for *JAK2*, *CALR*, and *MPL* testing under the auspices of the Clinical Laboratory Improvement Amendments. Laboratories that offer laboratory-developed tests must be licensed by the Clinical Laboratory Improvement Amendments for high-complexity testing. To date, the U.S. FDA has chosen not to require any regulatory review of this test.

### **Centers for Medicare and Medicaid Services (CMS)**

There is no national coverage determination (NCD). In the absence of an NCD, coverage decisions are left to the discretion of local Medicare carriers.

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### **Rationale/Source**

Evidence reviews assess whether a medical test is clinically useful. A useful test provides information to make a clinical management decision that improves the net health outcome. That is, the balance of benefits and harms is better when the test is used to manage the condition than when another test or no test is used to manage the condition.

The first step in assessing a medical test is to formulate the clinical context and purpose of the test. The test must be technically reliable, clinically valid, and clinically useful for that purpose. Evidence reviews assess the evidence on whether a test is clinically valid and clinically useful. Technical reliability is outside the scope of these reviews, and credible information on technical reliability is available from other sources.

### **JAK2 TESTING FOR A SUSPECTED MYELOPROLIFERATIVE NEOPLASM**

#### **Clinical Context and Test Purpose**

The purpose of *JAK2* testing of individuals with a suspected MPN is to establish a molecular genetic diagnosis of MPN to inform management decisions.

The question addressed in this evidence review is: In individuals with a suspected MPN, does the use of *JAK2* testing improve the net health outcome?

The following PICOTS were used to select literature to inform this review.

#### **Patients**

The relevant population of interest includes individuals with a suspected MPN.

#### **Interventions**

The test being considered is genetic testing for *JAK2*.

#### **Comparators**

The following practice is currently being used to make decisions about individuals with a suspected MPN: standard clinical management without genetic testing.

#### **Outcomes**

The potential beneficial outcomes of primary interest include establishing a molecular genetic diagnosis of PV, ET, or PMF to inform management decisions when test results are provided.

#### **Timing**

The time frame for outcomes measures varies from several months for the improvement of symptoms to long-term survival as a result of disease-related complications.

#### **Setting**

Patients with a suspected MPN are actively managed by hematologists and oncologists.

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### Technically Reliable

Assessment of technical reliability focuses on specific tests and operators and requires review of unpublished and often proprietary information. Review of specific tests, operators, and unpublished data are outside the scope of this evidence review and alternative sources exist. This evidence review focuses on the clinical validity and clinical utility.

### Clinically Valid

A test must detect the presence or absence of a condition, the risk of developing a condition in the future, or treatment response (beneficial or adverse).

Early reports have suggested that the specificity was 100%, although sensitivity was variable (as high as 97% in patients with PV but only 30% to 50% in patients with ET or PMF). A result of the extraordinary specificity observed was that, in the setting of evaluating a patient with a suspected Philadelphia chromosome (Ph)-negative MPN, the predictive value of a positive test also approached 100%. It was recognized within months of the discovery of this variant, that *JAK2* V617F testing could dramatically expedite diagnosis by reducing the need for complex workups of secondary or reactive causes of the observed proliferative process in *JAK2* V617F-negative classic MPNs. Two important caveats should be noted about this test: (1) a negative result cannot be used to rule out classic MPN and (2) a positive result is credible evidence that a classic MPN is present but alone is insufficient to subclassify the disease category. In recognition of the value of this marker for refining the diagnostic workup of patients suspected of having Ph-negative MPNs, several reports recommended new diagnostic algorithms. The 2002 WHO criteria were revised in 2008 and 2016 to incorporate genetic testing in patient workup.

James et al (2006) compared PV diagnosed using either WHO or the Polycythemia Vera Study Group criteria with a streamlined diagnostic approach for PV using a 2-step algorithm (elevated hematocrit levels and the presence of the *JAK2* V617F variant). Although the groups studied were small (45 patients with a Polycythemia Vera Study Group diagnosis of PV, 61 patients meeting WHO criteria), use of the 2-step algorithm resulted in a correct diagnosis in 96% (the Polycythemia Vera Study Group criteria) or 93% (WHO criteria) of patients with PV.

The 2016 WHO criteria specifically recommended testing for *JAK2* exon 12 variants in patients with suspected PV (presumably in patients who are *JAK2* V617F-negative). The criteria suggested testing for *JAK2* V617F or other clonal markers in patients with ET.

### Section Summary: Clinically Valid

Evidence of the clinical validity of *JAK2* V617F and exon 12 variant testing includes prospective studies and case series. In PV patients, the *JAK2* V617F variants were found in approximately 95% of cases while *JAK2* exon 12 variants were found in the 5%. In ET and PMF patients, *JAK2* V617F variants were detected in more than 50% of cases. Additionally, the 2016 WHO diagnostic criteria incorporated the *JAK2* V617F variants for PV, ET, and PMF and *JAK2* exon 12 variants for PV.

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### **Clinically Useful**

A test is clinically useful if the use of the results informs management decisions that improve the net health outcome of care. The net health outcome can be improved if patients receive correct therapy, or more effective therapy, or avoid unnecessary therapy, or avoid unnecessary testing.

### **Direct Evidence**

Direct evidence of clinical utility is provided by studies that have compared health outcomes for patients managed with and without the test. Because these are intervention studies, the preferred evidence would be from randomized controlled trials (RCTs).

Testing for *JAK2* V617F or *JAK2* exon 12 variants have potential clinical utility in several different clinical scenarios:

1. Diagnosis of patients with clinical, laboratory, or pathologic findings suggesting classic MPNs (PV, ET, or PMF);
2. Phenotyping of disease subtypes in patients with MPNs to establish disease prognosis;
3. Identification, selection, and monitoring of treatment.

### **Molecular Genetic Diagnosis for Ph-negative MPNs**

Diagnosis of Ph-negative MPNs is challenging due to the overlapping clinical features across MPNs, reactive processes, and complex diagnostic algorithms. The presence of *JAK2* V617F or *JAK2* exon 12 variants is considered a major criterion for the PV. The presence of a *JAK2* variant is also a major criterion for ET and PMF.

### **Molecular Profiling: Phenotype and Genotype Associations and Impact on Prognosis**

The use of *JAK2* V617F testing has been used as a front-line diagnostic test in the evaluation of Ph-negative MPN patients. Efforts have been made to link the presence of *JAK2* variants and the quantitative measurement of its allele burden to clinical features and biologic behavior. Unfortunately, due to differences in disease definitions, differences in methods of testing, differences in sample type (bone marrow vs circulating blood cells), and differences in study designs, the literature in this area is conflicting and inconclusive.

Because most patients with PV exhibit the *JAK2* V617F variant, attention has focused on differences in the disease's presence in the homozygous vs heterozygous state and on whether allele burden correlates with clinical or laboratory features. Studies have reported on a range of findings, including the association between homozygous states and older age, higher hemoglobin level at diagnosis, leukocytosis, more frequent pruritus, increased incidence of fibrotic transformation, and larger spleen volumes. Studies that compared quantitative measurements of allele burden with disease manifestations have demonstrated both a positive association and lack of an association with thrombosis, fibrotic transformation, and need for chemotherapy.

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The impact of the presence of the *JAK2* V617F variants in patients with ET is also controversial. In several studies, the presence of this variant has been associated with advanced age, higher hemoglobin levels, increased leukocyte count, lower platelet count, and a higher rate of transformation to PV. Discrepant results have been reported for thrombotic events and for fibrotic transformation. A meta-analysis by Dahabreh et al (2009) surveyed 394 studies on outcomes in ET. Reviewers concluded that thrombosis but not myelofibrosis or leukemia appear to be influenced by the presence of *JAK2* variants.<sup>38</sup> Reviewers cautioned that there was a need for prospective studies to determine how this information might be used in treatment choices.

Thrombotic effects have been reported to be most pronounced for splanchnic vascular events, and there has been little support for the use of testing in patients with more general thrombosis or primary thrombocytosis. Results for splanchnic events have been contradictory.

In a retrospective study that assessed *JAK2* V617F variants in patients treated for thrombosis in ET and in unselected patients with splanchnic vein thrombosis, Xavier et al (2010) reported that *JAK2* V617F variants were more common in patients with splanchnic vein thrombosis; further the study appeared to identify a subset of patients who might benefit from antiplatelet therapy. However, the outcomes of routine testing in both settings remain unclear. In an international collaborative study of patients with ET, Carobbio et al (2011) found that patients with *JAK2* V617F variants appeared at risk for arterial thrombosis but not for venous thrombosis.

### **Disease Monitoring**

A 2009 report by Hussein et al (2009) demonstrated that, although there was significant overlap in *JAK2* V617F allele burden among various MPN entities, quantitative measurements suggested discriminatory differences between patients with ET and the prefibrotic stage of PMF.

*JAK2* V617F variant status and allele burden appear particularly poorly defined in patients with PMF. In a series of confusing and noncongruent articles, it has been concluded that:

- Patients with *JAK2* V617F variants required fewer blood transfusions but exhibited poorer overall survival than those without the variant.
- Patients with *JAK2* V617F variants did not show differences in the incidence of thrombosis, overall survival, or leukemia-free survival.
- Patients with homozygous *JAK2* V617F variants showed an increased evolution toward large splenomegaly, need of splenectomy, and leukemic transformation.
- Patients with low allele burdens appeared to exhibit shortened survival, perhaps because they represented a myelodepleted subset of affected patients.

The most sensitive assay performed consistently across various quantitative PCR platforms and detected mutant allele (ie, minimal residual disease) in transplant recipients at a median of 22 weeks (range, 6-85 weeks) before relapse. The authors suggested that the assay could be used to guide management of

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patients undergoing allogeneic hematopoietic cell transplantation. Although the study supported the analytic validity of the assay, given the inconsistency of outcomes when *JAK2* V617F testing is used for treatment monitoring (described earlier), the utility of this assay or any *JAK2* V617F test for treatment monitoring is uncertain. Other investigators have studied methods to improve *JAK2* and *MPL* variant testing using quantitative PCR and novel approaches (eg, an electrochemical DNA biosensor).

### **Treatment**

#### *Treatment With Hydroxyurea*

Several reports have suggested that *JAK2* V617F–positive patients are more sensitive to treatment with hydroxyurea than *JAK2* V617F–negative patients. In a study of hydroxyurea treatment in patients with PV or ET harboring the *JAK2* V617F gene, Antonioli et al (2010) observed serial changes in allele burden. However, the value of these findings was unclear, and the authors concluded that serial testing in patients taking hydroxyurea should be confined to clinical studies.

#### *Treatment With JAK2 Inhibitors*

Due to the strong epidemiologic and biologic literature linking *JAK2* pathway variants to the occurrence of MPNs, there has been considerable recent attention on using *JAK2* as a molecular target for drug discovery. In preclinical and early clinical studies, a number of promising *JAK2* inhibitors have been identified, and reports have suggested that some are useful in symptom relief. Many patients with these diseases have good responses to cytotoxic drugs, and the natural course of the disease, particularly for PV and ET, can be quite indolent. Considerable study will be required to sort through the safety and efficacy of these new treatments before they enter routine clinical use. Several early-phase and preliminary treatment trials evaluating the safety and efficacy of tyrosine kinase inhibitors in patients with *JAK2* V617F–positive MPNs have been reported. It also has been noted that benefits from tyrosine kinase therapy may not be specific for *JAK2* V617F–positive MPNs but may be observed in wild-type disease as well.

In 2011, ruxolitinib (a JAK kinase inhibitor) was approved by the U.S. FDA for the treatment of intermediate- and high-risk myelofibrosis (including primary myelofibrosis, post-polycythemia vera myelofibrosis, and postessential thrombocythemia myelofibrosis) based on results from 2 RCTs. One, a double-blind RCT by Verstovsek et al (2012) assessing patients with intermediate- to high-risk myelofibrosis, randomized participants to twice-daily oral ruxolitinib (n=155) or to placebo (n=154) and followed them for 76 weeks (Controlled Myelofibrosis Study with Oral JAK Inhibitor Treatment [COMFORT-I]). The primary outcome (a  $\geq 35\%$  reduction in spleen volume at or after 24 weeks) was observed in 41.9% of patients treated with ruxolitinib compared with 0.7% in the placebo group ( $p < 0.001$ ). At the prospectively defined data cutoff of 32 weeks, there were 10 (6.5%) deaths in the ruxolitinib group and 14 (9.1%) deaths in the placebo group (Kaplan-Meier method,  $p = 0.33$ ). With 4 additional months of follow-up (median, 51 weeks total follow-up), there were 13 (8.4%) total deaths in the ruxolitinib group and 24 (15.6%) total deaths in the placebo group (Kaplan-Meier method,  $p = 0.04$ ). Myelofibrosis symptom score at 24 weeks improved 45.9% from baseline in patients who received ruxolitinib and 5.3% in placebo patients. Discontinuations due to adverse events were similar in the ruxolitinib (11%) and placebo (10.6%) groups. In a post hoc subgroup analysis of

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patients with the *JAK2* V617F variant, mean changes in spleen volume at 24 weeks were -34.6% in the ruxolitinib group and +8.1% in the placebo group; in patients without the variant, mean changes in spleen volume were -23.8% and +8.4%, respectively. Changes in total symptom score at 24 weeks in patients with the *JAK2* V617F variant were -52.6% in the ruxolitinib group and +42.8% in the placebo group (higher scores indicate more severe symptoms); in patients without the variant, changes in total symptom score were -28.1% and +37.2%, respectively.

A second trial by Harrison et al (2012) reached similar conclusions (COMFORT-II). Patients with intermediate- or high-risk primary myelofibrosis, postpolycythemia vera myelofibrosis, or postessential thrombocythemia myelofibrosis received oral ruxolitinib (n=146) or best available therapy (n=73). No differences in overall survival were observed between the 2 groups at 48 weeks. Twenty-eight percent of patients in the ruxolitinib group had at least a 35% reduction in spleen volume at 48 weeks compared with 0% in the control group (p<0.001). In the *JAK2* V617F–positive subgroup, the incidence of spleen reduction was 33% in the ruxolitinib group and 0% in the control group; in the *JAK2* V617F–negative subgroup, the incidence of spleen reduction was 14% in the ruxolitinib group and 0% in controls. In the ruxolitinib group, patients had an improved overall quality of life and a reduction in myelofibrosis symptoms compared with no benefit to the control group. Serious adverse events were similar between groups: anemia occurred in 5% of patients in the ruxolitinib group and 4% of the control group, pneumonia occurred in 1% of the ruxolitinib group and 5% of the control group, and 8% of patients in the ruxolitinib group and 5% in the control group discontinued treatment.

A follow-up to the COMFORT-I trial, published by Verstovsek et al (2015), provided data on a median 3-year follow-up. At a median of 149 weeks (range, 19-175 weeks), 77 (49.7%) of the 155 patients originally randomized to ruxolitinib were still receiving therapy. One hundred eleven of 154 patients whom originally received placebo crossed over to receive ruxolitinib, and, of these, 57 (51.4%) were still receiving the drug. Of the patients originally randomized to therapy, discontinuation rates were 21% at 1 year, 35% at 2 years, and 51% at year 3. Reasons for discontinuing ruxolitinib were disease progress (23.1%), adverse events (19.2%), death (19.2%), and withdrawal of consent (15.4%). The initial primary outcome measure of this study was a reduction in spleen volume, and, in this follow-up study, reductions in spleen size were durable with longer term treatment. Mean percentage change from baseline was -31.6% at week 24 and -34.1% at week 144. Of patients initially randomized to ruxolitinib, 91 (59%) of 155 of patients achieved a 35% or more reduction in spleen volume at any time during study follow-up. The probability of maintaining this same reduction for at least 132 weeks was 0.53, and more than 80% of patients maintained a reduction of at least 10%. Regarding overall survival, 42 patients randomized to ruxolitinib died while 54 in the placebo group died. With a median follow-up of 149 weeks for both the ruxolitinib and placebo groups, the hazard ratio for overall survival favored patients in the ruxolitinib arm (hazard ratio, 0.69; 95% confidence interval, 0.46 to 1.03; p=0.067). Anemia and thrombocytopenia were the most common adverse hematologic events and were highest during the first 6 months of therapy, both of which subsequently increased to a new steady state. The most common nonhematologic adverse events, which occurred more commonly in the ruxolitinib group, were ecchymosis (18.7%), dizziness (14.8%), and headache (14.8%). Additionally, more

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patients treated with study drug developed urinary tract infections and herpes zoster, although the incidence of these infections did not increase with length of therapy. All herpes zoster infections were grade 1 or 2, and no other opportunistic infections were identified during follow-up. Four new cases of acute myeloid leukemia were reported since the first analysis published in 2012, two in patients originally randomized to ruxolitinib and two in the placebo arm, for a total of 8 cases since the study began. The rate of leukemic transformation per person-year of ruxolitinib exposure was 0.0121 per person-year and 0.0233 per person-year in patients originally randomized to ruxolitinib or placebo, respectively.

Although identification of a drug producing long-term remission (like imatinib in chronic myeloid leukemia ) is the ultimate goal, discovery likely will be complicated by the complexity of molecular processes occurring in patients with these other MPNs and the fact that *JAK2* V617F alone does not appear to be a unique or absolutely necessary event in many patients with these diseases. The role of the *JAK2* V617F variant in selecting or monitoring patients for new treatments or residual neoplasia remains undefined.

### *Treatment With Imetelstat*

Other drugs to treat MPNs are being evaluated. Two studies have described imetelstat, which inhibits telomerase enzymatic activity. One is a pilot study by Tefferi et al (2015) evaluating the use of imetelstat in patient myelofibrosis, while the other a phase 2 study by Baerlocher et al (2015) assessing imetelstat in patients with ET. Both studies demonstrated hematologic and molecular responses in patients with *JAK2* variants, although clinically significant myelosuppression may be an obstacle to its use.

Results of a phase 2 study for pacritinib were published by Komrokji et al (2015). This drug is a Janus kinase 2, *JAK2* V617F, and Fms-like tyrosine kinase 3 inhibitor, which has demonstrated a favorable safety profile with promising efficacy in phase 1 studies in patients with primary and secondary myelofibrosis.

### **Section Summary: Clinically Useful**

Direct evidence for the clinical utility of *JAK2* testing includes meta-analyses, retrospective studies, and RCTs. Evidence for *JAK2* testing for phenotyping and monitoring provides conflicting results. However, the presence of *JAK2* V617F or *JAK2* exon 12 variants is considered a major criterion for the diagnosis of PV, ET, and PMF. *JAK2* V617F and *JAK2* exon 12 testing allow secondary or reactive erythrocytosis or thrombocytosis to be differentiated from PV, ET, and PMF.

## **MPL TESTING FOR A SUSPECTED MYELOPROLIFERATIVE NEOPLASM**

### **Clinical Context and Test Purpose**

The purpose of *MPL* testing of individuals with a suspected MPN is to establish a molecular genetic diagnosis of MPN to inform management decisions.

The question addressed in this evidence review is: In individuals with a suspected MPN, does the use of *MPL* testing result in improvement in the net health outcome?

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The following PICOTS were used to select literature to inform this review.

### **Patients**

The relevant population of interest includes individuals with a suspected MPN.

### **Interventions**

The test being considered is genetic testing for *MPL*.

### **Comparators**

The following practice is currently being used to make decisions about treating individuals with a suspected MPN: standard clinical management without genetic testing.

### **Outcomes**

The potential beneficial outcomes of primary interest include establishing a molecular genetic diagnosis of ET or PMF to inform management decisions when test results are positive.

### **Timing**

The time frame for outcomes measures varies from several months for the improvement of symptoms to long-term survival as a result of disease-related complications.

### **Setting**

Patients with a suspected MPN are actively managed by hematologists and oncologists.

### **Technically Reliable**

Assessment of technical reliability focuses on specific tests and operators and requires review of unpublished and often proprietary information. Review of specific tests, operators, and unpublished data are outside the scope of this evidence review and alternative sources exist. This evidence review focuses on the clinical validity and clinical utility.

### **Clinically Valid**

A test must detect the presence or absence of a condition, the risk of developing a condition in the future, or treatment response (beneficial or adverse).

Pikman et al (2006) surveyed *JAK2* variant–negative patients with suspected ET and PMF to determine whether variants in pathways complementary to *JAK2* signaling could be identified. A genetic variant of the thrombopoietin receptor gene (*MPL*) at codon 515 (exon 10) causing a change from tryptophan to leucine (*MPL* W515L) was discovered.

Subsequent studies have identified additional variants including *MPL* S505N, *MPL* W515Ki, and *MPL* W515Kii in a small but growing number of patients with ET and PMF (see Table 3). Although these variants

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can be found in both *JAK2* V617F–positive and –negative patients, they are of particular value in the latter group for establishing a clonal basis of the observed disease process.

**Table 3. Frequency of *MPL* 515 Variants in Patients With a Ph-Negative MPN**

Study	Variant Detection Method	PV	ET	PMF	Normals	Other MPNs
Pikman et al (2006)	DNA sequencing	0/10 (0)	0/50 (0)	4/45 (8.8)	0/270 (0)	
Pardanani et al (2006)	Site 1: PCR with DNA sequencing	0/38 (0)	2/167 (1)	8/198 (4)	0/64 (0)	3/118 (2.5)
	Site 2: DNA sequencing	0/204 (0)	2/151 (1)	5/92 (5)		
Beer et al (2008)	PCR testing	–	• Prel: 3/88 (3.4) • Pros: 32/776 (4.1)	• Prel: 8/112 (7.1)	–	–
Pancrazzi et al (2008)	PCR testing	0/50 (0)	–	19/217 (8.7)	0/60 (0)	–
Ruan et al (2010)	PCR testing	0/32 (0)	7/199 (3.5)	3/24 (12.5)	0/52 (0)	0/29 (0)
Schnittger et al (2009)	PCR testing	–	19/356 (5.3)	10/193 (5.2)	–	2/269 (0.8)

Values are n/N (%).

ET: essential thrombocythemia; MPN: myeloproliferative neoplasm; PCR: polymerase chain reaction; Ph: Philadelphia chromosome; PMF: primary myelofibrosis; Prel: preliminary; Pros: prospective; PV: polycythemia vera.

Similar to observations about *JAK2* V617F–negative variants in exon 12, *MPL* exon 10 variants appear to demonstrate an autoinhibitory role leading to receptor activation in the absence of thrombopoietin binding. Expression of the *MPL* allele resulted in cytokine-independent growth of 3 independent cell lines, and transplantation of mice with bone marrow expressing this allele resulted in a distinct myeloproliferative disorder.

The 2016 WHO criteria specifically cited testing *MPL* exon 10 variants in patients with ET and PMF. The criteria included testing for *MPL* exon 10 variants in patients with ET and PMF.

### Section Summary: Clinically Valid

Evidence of the clinical validity *MPL* exon 10 variants includes case series. In patients with ET and PMF, the *MPL* exon 10 variants were found in approximately 5% of cases. In ET and PMF patients, the 2016 WHO incorporated *MPL* exon 10 variants as a major criterion for the diagnosis of ET and PMF.

### Clinically Useful

A test is clinically useful if the use of the results informs management decisions that improve the net health outcome of care. The net health outcome can be improved if patients receive correct therapy, or more effective therapy, or avoid unnecessary therapy, or avoid unnecessary testing.

### Direct Evidence

Direct evidence of clinical utility is provided by studies that have compared health outcomes for patients managed with and without the test. Because these are intervention studies, the preferred evidence would be from RCTs.

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Testing for *MPL* exon 10 variants has potential clinical utility in several different clinical scenarios:

1. Diagnosis of patients with clinical, laboratory, or pathologic findings suggesting classic ET or PMF;
2. Phenotyping of disease subtypes in patients with ET and PMF to establish disease prognosis.

*MPL* exon 10 variants are detected in approximately 5% of patients with ET and PMF. No RCTs were identified that used the results of *MPL* exon 10 variant testing to guide treatment and management decisions.

### **Chain of Evidence**

Indirect evidence on clinical utility rests on clinical validity. If the evidence is insufficient to demonstrate test performance, no inferences can be made about clinical utility.

The goals of treatment and management for ET are to alleviate symptoms and minimize complications of the disease such as thrombotic events and bleeding, though establishing the diagnosis does not lead to preventive management. For PMF, hematopoietic cell transplantation is the only treatment with curative potential while most other treatment options focus on alleviation of symptoms. However, in both ET and PMF, establishing the diagnosis through *MPL* genetic testing does not result in changes in management that would be expected to improve net health outcome.

### **Section Summary: Clinically Useful**

Direct evidence for the clinical utility of *MPL* testing is lacking. While *MPL* exon 10 testing has potential utility in diagnosing ET and PMF using the 2016 WHO major criteria for MPNs and excluding reactive or secondary causes of thrombocytosis, there is no change in management that would be expected to improve the net health outcome. Thus, clinical utility has not been established.

## **CALR2 TESTING FOR A SUSPECTED MYELOPROLIFERATIVE NEOPLASM**

### **Clinical Context and Test Purpose**

The purpose of *CALR* testing of individuals with a suspected MPN is to establish a molecular genetic diagnosis of MPN to inform management decisions.

The question addressed in this evidence review is: In individuals with a suspected MPN, does the use of *CALR* testing result in improvement in health outcomes?

The following PICOTS were used to select literature to inform this review.

### **Patients**

The relevant population of interest includes individuals with a suspected MPN.

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### **Interventions**

The test being considered is genetic testing for *CALR*.

### **Comparators**

The following practice is currently being used to make decisions about individuals with a suspected MPN: standard clinical management without genetic testing.

### **Outcomes**

The potential beneficial outcomes of primary interest include establishing a molecular genetic diagnosis of ET or PMF to inform management decision when test results are positive.

### **Timing**

The time frame for outcomes measures varies from several months for the improvement of symptoms to long-term survival as a result of disease-related complications.

### **Setting**

Patients with a suspected MPN are actively managed by hematologists and oncologists.

### **Technically Reliable**

Assessment of technical reliability focuses on specific tests and operators and requires review of unpublished and often proprietary information. Review of specific tests, operators, and unpublished data are outside the scope of this evidence review and alternative sources exist. This evidence review focuses on the clinical validity and clinical utility.

### **Clinically Valid**

A test must detect the presence or absence of a condition, the risk of developing a condition in the future, or treatment response (beneficial or adverse).

Klampfl et al (2013) performed whole exome sequencing in patients with PMF who were previously identified as negative for *JAK2* and *MPL* variants to search for a novel molecular marker for MPNs. Somatic insertions or deletions (indels) in exon 9 of *CALR* were initially detected in a small cohort of 6 patients using whole exome sequencing. Subsequent resequencing of 1107 samples from patients with *JAK2*-negative and *MPL*-negative MPNs found that *CALR* exon 9 indels were absent in all cases of PV in this population. For patients with ET and PMF, *CALR* variants were detected in 67% and 88%, respectively. In total, 36 unique indels were identified resulting in a frameshift that led to mutated calreticulin proteins with novel C-terminal peptides. Patients with *CALR* exon 9 indels were also found to have longer overall survival and lower risk of thrombosis.

Nangalia et al (2013) performed whole exome sequencing on 1345 hematologic cancers, 1517 other cancers, and 550 controls to assess the presence or absence of variants in *CALR*. Nineteen unique

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variants located in exon 9 resulting +1 base pair frameshift were detected from a total of 148 *CALR* variants identified. *CALR* variants were detected in most patients with *JAK2*-negative MPNs.

Rumi et al (2014) reported on *CALR* exon 9 variants somatically acquired in familial cases of ET and PMF. *CALR* exon 9 indels were found in 20% to 25% of sporadic patients with ET and PMF. In the small cohort of patients who had ET with *CALR* variants, a lower cumulative incidence of thrombosis and disease progression was noted compared with ET patients who had *JAK2* V617F variants.

### **Section Summary: Clinically Valid**

Evidence of the clinical validity *CALR* variants includes retrospective studies and case series. In patients with ET and PMF, the *CALR* exon 9 indels were found in approximately 20% to 25% of cases, respectively. In ET and PMF patients, the 2016 WHO incorporated *CALR* exon 9 variants as a major criterion for the diagnosis of ET and PMF.

### **Clinically Useful**

A test is clinically useful if the use of the results informs management decisions that improve the net health outcome of care. The net health outcome can be improved if patients receive correct therapy, or more effective therapy, or avoid unnecessary therapy, or avoid unnecessary testing.

### **Direct Evidence**

Direct evidence of clinical utility is provided by studies that have compared health outcomes for patients managed with and without the test. Because these are intervention studies, the preferred evidence would be from RCTs.

Testing for *CALR* exon 9 variants has potential clinical utility in several different clinical scenarios:

1. Diagnosis of patients with clinical, laboratory, or pathologic findings suggesting classic ET or PMF;
2. Phenotyping of disease subtypes in patients with ET and PMF to establish disease prognosis.

*CALR* exon 9 variants are detected in approximately 5% of patients with ET and PMF. No RCTs were identified that used the results of *CALR* exon 9 variant testing to guide treatment and management decisions.

Rumi et al (2014) described *JAK2* and *CALR* variant status in defining subtypes of ET with substantially different clinical course and outcomes. The presence of a *CALR* variant was associated with lower risk for thrombotic events in ET cases compared with *JAK2* V617F ET cases. No significant differences in myelofibrotic transformations were noted. However, establishing the diagnosis through *CALR* genetic testing does not result in changes in management that would be expected to improve net health outcome.

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### **Chain of Evidence**

Indirect evidence on clinical utility rests on clinical validity. If the evidence is insufficient to demonstrate test performance, no inferences can be made about clinical utility.

The goals of treatment and management for ET are to alleviate symptoms and minimize complications of the disease such as thrombotic events and bleeding, though establishing the diagnosis does not lead to preventive management. For PMF, hematopoietic cell transplantation is the only treatment with curative potential while most other treatment options focus on alleviation of symptoms.

### **Section Summary: Clinically Useful**

Direct evidence for the clinical utility of *CALR* testing is lacking. While *CALR* exon 9 testing has potential clinical utility in diagnosing ET and PMF using the 2016 WHO major criteria for MPNs and excluding reactive or secondary causes of thrombocytosis, there is no change in management that would be expected to improve net health outcome. Thus, clinical utility has not been established.

### **SUMMARY OF EVIDENCE**

For individuals with a suspected MPN who receive genetic testing for *JAK2*, the evidence includes case series, retrospective studies, meta-analyses, and RCTs. Relevant outcomes include overall survival, disease-specific survival, test accuracy and validity, and resource utilization. For patients with suspected Ph-negative MPN, *JAK2* variants are found in nearly 100% of those with PV, 60% to 65% of those with essential thrombocythemia, and 60% to 65% of those with primary myelofibrosis. In individuals with suspected MPN, a positive genetic test for *JAK2* satisfies a major criterion for the 2016 World Health Organization classification for Ph-negative MPNs and eliminates secondary or reactive causes of erythrocytosis and thrombocythemia from the differential diagnosis. The presence of a documented *JAK2* variant may aid in the selection of ruxolitinib, a *JAK2* inhibitor; ruxolitinib, however, is classified as a second-line therapy. The evidence is sufficient to determine that the technology results in a meaningful improvement in the net health outcome.

For individuals with a suspected MPN who receive genetic testing for *MPL*, the evidence includes case series and retrospective studies. Relevant outcomes include overall survival, disease-specific survival, test accuracy and validity, and resource utilization. For patients with suspected Ph-negative MPN, *MPL* variants are found in approximately 5% of those with ET and PMF. In individuals with suspected MPN, a positive genetic test for *MPL* satisfies a major criterion for the 2016 World Health Organization classification for ET and PMF and eliminates secondary or reactive causes of thrombocythemia from the differential diagnosis. The goal of ET treatment is to alleviate symptoms and minimize thrombotic events and bleeding irrespective of *MPL* variant status. For PMF, hematopoietic cell transplantation is the only treatment with curative potential while most other treatment options focus on symptom alleviation.

However, in both ET and PMF, establishing the diagnosis through *MPL* genetic testing does not in and of itself result in changes in management that would be expected to improve the net health outcome. Thus,

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clinical utility has not been established. The evidence is insufficient to determine that the technology results in a meaningful improvement in the net health outcome.

For individuals with a suspected MPN who receive genetic testing for *CALR*, the evidence includes case series and retrospective studies. Relevant outcomes include overall survival, disease-specific survival, test accuracy and validity, and resource utilization. For patients with suspected Ph-negative MPN, *CALR* variants are found in approximately 20% to 25% of those with ET and PMF. For individuals with suspected MPN, a positive genetic test for *CALR* satisfies a major criterion for the WHO classification for ET and PMF and eliminates secondary or reactive causes of thrombocytopenia from the differential diagnosis. The goal of ET treatment is to alleviate symptoms and minimize thrombotic events and bleeding irrespective of *CALR* variant status. For PMF, hematopoietic cell transplantation is the only treatment with curative potential while most other treatment options focus on symptom alleviation. However, in both ET and PMF, establishing the diagnosis through *CALR* genetic testing does not result in changes in management that would be expected to improve the net health outcome. Thus, clinical utility has not been established. The evidence is insufficient to determine that the technology results in a meaningful improvement in the net health outcome.

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### **Policy History**

Original Effective Date: 04/23/2014

Current Effective Date: 10/17/2018

- |            |   |
|------------|---|
| 04/03/2014 | Medical Policy Committee review   |
| 04/23/2014 | Medical Policy Implementation Committee approval. New policy.                     |
| 06/25/2015 | Medical Policy Committee review   |
| 07/15/2015 | Medical Policy Implementation Committee approval. Coverage eligibility unchanged. |
| 06/30/2016 | Medical Policy Committee review   |
| 07/20/2016 | Medical Policy Implementation Committee approval. Coverage eligibility unchanged. |
| 01/01/2017 | Coding update: Removing ICD-9 Diagnosis Codes                                     |
| 07/06/2017 | Medical Policy Committee review   |
| 07/19/2017 | Medical Policy Implementation Committee approval. Coverage eligibility unchanged. |
| 10/05/2017 | Medical Policy Committee review   |

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10/18/2017 Medical Policy Implementation Committee approval. CALR testing added to the policy. Policy revised with updated genetics nomenclature. Policy statements updated to clarify that JAK2 testing is medically necessary for PV, ET and PMF and added recommendation for documentation of serum erythropoietin levels prior to JAK2 testing, MPL testing is medically necessary for ET and PMF, and new medical necessity statement added for CALR testing in ET and PMF. Title changed to "JAK2, MPL, and CALR Testing for Myeloproliferative Neoplasms".

04/01/2018 Coding update

10/04/2018 Medical Policy Committee review

10/17/2018 Medical Policy Implementation Committee approval. Policy guidelines updated.

Next Scheduled Review Date: 10/2019

### Coding

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Code Type	Code
CPT	0017U , 81219, 81270, 81402, 81403 Code to added effective 1/1/2018:0027U
HCPCS	No codes
ICD-10 Diagnosis	C92.10 C92.11 C92.12 C96.2 D45 D47.1 D47.3

\*Investigational – A medical treatment, procedure, drug, device, or biological product is Investigational if the effectiveness has not been clearly tested and it has not been incorporated into standard medical practice. Any determination we make that a medical treatment, procedure, drug, device, or biological product is Investigational will be based on a consideration of the following:

- A. Whether the medical treatment, procedure, drug, device, or biological product can be lawfully marketed without approval of the U.S. FDA and whether such approval has been granted at the time the medical treatment, procedure, drug, device, or biological product is sought to be furnished; or

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- B. Whether the medical treatment, procedure, drug, device, or biological product requires further studies or clinical trials to determine its maximum tolerated dose, toxicity, safety, effectiveness, or effectiveness as compared with the standard means of treatment or diagnosis, must improve health outcomes, according to the consensus of opinion among experts as shown by reliable evidence, including:
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- A. In accordance with nationally accepted standards of medical practice;
- B. Clinically appropriate, in terms of type, frequency, extent, level of care, site and duration, and considered effective for the patient's illness, injury or disease; and
- C. Not primarily for the personal comfort or convenience of the patient, physician or other health care provider, and not more costly than an alternative service or sequence of services at least as likely to produce equivalent therapeutic or diagnostic results as to the diagnosis or treatment of that patient's illness, injury or disease.

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