

<b>Subject: Hematopoietic Stem Cell Transplantation for Acute Myelogenous Leukemia (AML)</b>		<b>Original Effective Date: 10/31/12</b>
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**DISCLAIMER**

*This Molina Clinical Policy (MCP) is intended to facilitate the Utilization Management process. It expresses Molina's determination as to whether certain services or supplies are medically necessary, experimental, investigational, or cosmetic for purposes of determining appropriateness of payment. The conclusion that a particular service or supply is medically necessary does not constitute a representation or warranty that this service or supply is covered (i.e., will be paid for by Molina) for a particular member. The member's benefit plan determines coverage. Each benefit plan defines which services are covered, which are excluded, and which are subject to dollar caps or other limits. Members and their providers will need to consult the member's benefit plan to determine if there are any exclusion(s) or other benefit limitations applicable to this service or supply. If there is a discrepancy between this policy and a member's plan of benefits, the benefits plan will govern. In addition, coverage may be mandated by applicable legal requirements of a State, the Federal government or CMS for Medicare and Medicaid members. CMS's Coverage Database can be found on the CMS website. The coverage directive(s) and criteria from an existing National Coverage Determination (NCD) or Local Coverage Determination (LCD) will supersede the contents of this Molina Clinical Policy (MCP) document and provide the directive for all Medicare members.<sup>1</sup>*

**DESCRIPTION OF PROCEDURE/SERVICE/PHARMACEUTICAL**<sup>30 31</sup>

*Acute Myelogenous Leukemia*  
 Acute leukemia's comprise a heterogeneous group of neoplastic disorders that arise from malignant transformation of blood-forming, or hematopoietic, stem cells. Malignant transformation typically involves chromosomal rearrangements (translocations), deletions, or additions, which disturb the normal control of cell division, allowing affected cells to multiply without restraint. Clones, or leukemic cells, arising from such transformation particularly influence the development of white blood cells (WBCs), or leukocytes, and rapidly proliferate in the bone marrow, ultimately replacing normal cells and causing anemia, thrombocytopenia, and granulocytopenia. After release into the blood stream, leukemic cells can infiltrate any organ or site and often spread to the liver, spleen, lymph nodes, central nervous system (CNS), and gonads, where they continue to grow and divide, resulting in small tumors, inflammation, and/or organ damage and failure. Acute myeloid leukemia (AML) also called acute myeloblastic leukemia, acute myelogenous leukemia, and acute nonlymphocytic leukemia (ANLL) is an aggressive disease in which too many myeloblasts or immature white blood cells that are not lymphoblasts are found in the bone marrow and blood. Two methods are commonly used to classify AML. The French-American-British (FAB) Cooperative Group classification is based on morphological-histochemical cell characteristics and identifies eight subtypes of AML, categorized as M0-M7. The newer, World Health Organization Classification System incorporates clinical, morphologic, immunophenotypic, cytogenetic and molecular markers that can be used to direct treatment that include 5 major subcategories of AML: 1) AML with recurrent genetic abnormalities; 2) AML with multilineage dysplasia; 3)

therapy-related AML and myelodysplasia (MDS); 4) AML not otherwise categorized; and 5) acute leukemia of ambiguous lineage. Certain gene and cytogenetic abnormalities have been identified as high-risk for a poor prognosis with chemotherapy. These include internal tandem duplication of the FLT3 gene, mutation of the tp53 gene, deletions of the long arms or monosomies of chromosomes 5 or 7; translocations or inversions of chromosome 3, t(6;9), t(9;22) and abnormalities of chromosome 11q23, t(10;11) translocation, t(1;22)(p13;q13) translocation, trisomy 8, and certain antigens/glycoproteins.

Most children and adults with newly diagnosed AML undergo systemic multiagent chemotherapy designed to induce disease remission (induction therapy). These aggressive treatment approaches produce severe bone marrow aplasia and suppression of the hematopoietic system, which may lead to morbidity and mortality from infection or hemorrhage. Therefore, therapy is combined with appropriate supportive care involving early recognition and treatment of infection and, when necessary, red blood cell and platelet transfusions. With effective anticancer agents and appropriate supportive care, complete remission (CR) occurs in 75% to 90% of the children and 60% to 70% of the adults with AML. Even with treatment most patients relapse and ultimately die from leukemia. Among those who achieve first CR (CR1), disease-free survival has averaged only 40% at 5 years in children and overall survival with or without disease has averaged only 25% at  $\geq 3$  years in adults. Since undetected minimal residual disease is a major cause of relapse, patients in CR usually undergo a second phase and, often, a third phase of multiagent chemotherapy known as consolidation therapy and intensification therapy, respectively, which frequently employ different agents and/or higher doses than used in induction therapy in an attempt to eradicate residual disease. High-dose chemotherapy may be administered for this purpose but also ablates normal marrow (myeloablation), thereby destroying the hematopoietic system.

### *Stem Cell Transplantation*

Stem-cell transplantation refers to transplantation of hematopoietic stem cells (HSCs) from a donor into a patient. HSCs are immature cells that can develop into any of the three types of blood cells (red cells, white cells or platelets). HSCs are created in the bone marrow and are found in the bone marrow and peripheral blood. There is also a high concentration of HSCs in umbilical-cord blood. Hematopoietic stem-cell transplantation (HSCT) can be either autologous (using the person's own stem cells) or allogeneic (using stem cells from a donor). In allogeneic HSCT, it is preferable for donors to have a human leukocyte antigen (HLA) type that is identical to the recipient. Matching is performed on the basis of variability at three or more loci of the HLA gene (e.g., HLA-A, HLA-B, HLA-DRB1). As HLA variability increases, transplant-related morbidity and mortality, including graft rejection and graft-versus-host disease, also increase. For patients who lack an HLA-matched sibling, alternative sources of donor grafts include suitably HLA-matched adult unrelated donors, umbilical cord blood stem cells, and partially HLA-mismatched, or HLA-haploidentical, related donors.

### **RECOMMENDATION**<sup>3-36</sup>

**All transplants require prior authorization from the Corporate Transplant Department. Solid organ transplant requests will be reviewed by the Corporate Senior Medical Director or qualified clinical designee. All other transplants will be by the Corporate Senior Medical Director or covering Medical Director. If the criteria are met using appropriate NCD and/or LCD guidelines, state regulations and/or MCP policies the Corporate Senior Medical Director's designee can approve the requested transplant.**

**Members must meet UNOS/OPTN policies and guidelines for pretransplantation evaluation and listing criteria and the diagnosis must be made by a Specialist in the Disease and or Transplant Surgeon.**

**Pre-Transplant Evaluation:** <sup>30 36</sup>

Criteria for transplant evaluation include all of the following:

- History and physical examination
- Psychosocial evaluation and clearance:
  - No behavioral health disorder by history or psychosocial issues:
    - if history of behavioral health disorder, no severe psychosis or personality disorder
    - mood/anxiety disorder must be excluded or treated
    - member has understanding of surgical risk and post procedure compliance and follow-up required
  - Adequate family and social support
- EKG
- Chest x-ray
- Cardiac clearance in the presence of any of the following:
  - chronic smokers
  - > 50 years age
  - those with a clinical or family history of heart disease or diabetes
- Pulmonary clearance if evidence of pulmonary artery hypertension (PAH) or chronic pulmonary disease
- Neurological exam and clearance for transplant: [ONE]
  - Normal exam by H&P
  - Abnormal neurological exam with positive findings: [ONE]
    - Lumbar puncture normal cytology
    - Lumbar puncture with cytological exam abnormal: CNS disease treated prior to clearance
- Performance Status : [ONE]
  - Karnofsky score 70-100%; or
  - Eastern Cooperative Oncology Group (ECOG) grade 0-2
- Lab studies:
  - \*Complete blood count, Kidney profile (blood urea nitrogen, creatinine), electrolytes, calcium, phosphorous, albumin, liver function tests, Coagulation profile (prothrombin time, and partial thromboplastin time)
  - \*Serologic screening for HIV, Epstein Barr virus (EBV), Hepatitis virus B (HBV), and Hepatitis C(HCV), cytomegalovirus (CMV), RPR and/or FTA:
    - If HIV positive all of the following are met:
      - CD4 count >200 cells/mm-3 for >6 months
      - HIV-1 RNA undetectable
      - On stable anti-retroviral therapy >3 months
      - No other complications from AIDS (e.g., opportunistic infection, including aspergillus, tuberculosis, coccidioides mycosis, resistant fungal infections, Kaposi's sarcoma, or other neoplasm)

- If abnormal serology need physician plan to address and/or treatment as indicated
  - UDS (urine drug screen) if patient is current or gives a history of past drug abuse
- ❑ \*Colonoscopy (if indicated or if patient is 50 ≥ older should have had an initial screening colonoscopy, after initial negative screening requires follow up colonoscopy every ten years) with complete workup and treatment of abnormal results as indicated
- ❑ \*GYN examination with Pap smear for women ≥21 to ≤ 65 years of age or indicated (not indicated in women who have had a TAH or TVH) with in the last three year with complete workup and treatment of abnormal results as indicated

Within the last 12 months:

- ❑ Dental examination or oral exam showing good dentition and oral care or no abnormality on panorex or plan for treatment of problems pre or post-transplant
- ❑ \*Mammogram (if indicated or > age 40) with complete workup and treatment of abnormal results as indicated
- ❑ \*PSA if history of prostate cancer or previously elevated PSA with complete workup and treatment of abnormal results as indicated

*\*Participating Centers of Excellence may waive these criteria*

### **Criteria for Hematopoietic Allogeneic Stem Cell transplantation (HSCT) Transplantation:**

1. ***Hematopoietic Allogeneic stem-cell transplantation (HSCT) ablative or non-myeloablative*** from a human leukocyte antigen (HLA)-matched donor (i.e., at least six out of eight match of the HLA-A, HLA-B, HLA-C and HLA-DRB1 markers) or haploidentical related donor (sharing a haplotype; having the same alleles at a set of closely linked genes on one chromosome)<sup>26 33</sup> or cord blood when there are no matched sibling or unrelated donors (i.e. at least four out of six match of the HLA-A, HLA-B and HLA-DRB-1 markers) may be authorized in adults and children for the treatment of acute myelogenous leukemia (AML) when ANY of the following criteria are met:

- ❑ All pre-transplant criteria are met; and
- ❑ In **adults** who are > age 18 with any of the following:
  - history of myelodysplastic syndrome (MDS)
  - failed induction therapy: presence of leukemia blasts in the blood, bone marrow or any extramedullary site after 4-6 weeks of chemotherapy
  - high white blood cell count (WBC) > 100,000 at diagnosis
  - AML after first relapse
  - extramedullary disease outside the bone marrow especially affecting central nervous system
  - requiring > one cycle to achieve remission
  - Complete first remission (CR-1)\* (See definition below)
  - Poor to intermediate risk stratification (See risk stratification table below\*\*) <sup>33</sup>
- ❑ In **children** who are < age 18 with any of the following:
  - in children who are < 2 years at diagnosis
  - failed induction therapy: presence of leukemia blasts in the blood, bone marrow or any extramedullary site after 4-6 weeks of chemotherapy
  - high white blood cell count (WBC) > 100,000 at diagnosis

- AML after first relapse
- extramedullary disease outside the bone marrow especially affecting central nervous system
- requiring > one cycle to achieve remission
- Abnormality of chromosome 5 or 7
- Complete first remission (CR-1)\* (See definition below)
- Poor to intermediate risk stratification (See risk stratification table below\*\*) <sup>33</sup>

**\*Note:** Complete first remission (CR-1) is defined by bone marrow biopsy as [BOTH]: <sup>31 32</sup>

- bone marrow is normocellular with no more than 5% blasts; and
- no signs or symptoms of the disease

<b>**Risk Status of AML Based on Cytogenetic and Molecular Factors</b> <sup>32</sup>		
<i>Risk Status</i>	<i>Cytogenetic Factors</i>	<i>Molecular Abnormalities</i>
Favorable risk	Core binding factor: Inv(16), t(8;21), t(16;16) or t(15;17)	Normal cytogenetics: NPM1 mutation in the absence of FLT3-ITD or isolated biallelic CEBPA mutation
Intermediate risk	Normal cytogenetics: +8 alone, t(9;11) or Other non-defined	c-KIT mutation in patients with t(8;21), inv(16) or t(16;16)
Poor risk	Complex (3 or more abnormalities) -5, -7, 5q-, 7q-, +8, Inv3, t(3;3), t(6;9), t(9;22) Abnormalities of 11q23, excluding t(9;11)	Normal cytogenetics with FLT3-ITD mutation TP53 mutation

**OR**

- Second or subsequent complete remission (CR-2) following complete first remission (CR-1) defined by bone marrow biopsy as [BOTH]:
  - bone marrow is normocellular with no more than 5% blasts; and
  - no signs or symptoms of the disease

**AND**

- The requesting transplant recipient should not have any of the following **absolute contraindications**:
  - Cardiac, pulmonary, and nervous system disease that cannot be corrected and is a prohibitive risk for surgery
  - Malignant neoplasm with a high risk for reoccurrence, non-curable malignancy (excluding localized skin cancer)
  - Systemic and/or uncontrolled infection
  - AIDS (CD4 count < 200cells/mm3)
  - Unwilling or unable to follow post-transplant regimen
    - ◇ Documented history of non-compliance
    - ◇ Inability to follow through with medication adherence or office follow-up
  - Chronic illness with one year or less life expectancy
  - Limited, irreversible rehabilitation potential

- Active untreated substance abuse issues, requires documentation supporting free from addiction for minimally 6 months if previous addiction was present
  - No adequate social/family support
- The requesting transplant recipient should be evaluated carefully and potentially treated if the following **relative contraindications** are present:
- Irreversible lung disease patients require consultation and clearance by a Pulmonologist prior to consideration of transplantation, this includes the following:
    - Smoking, documentation supporting free from smoking for 6 months
    - Active peptic ulcer disease
    - Active gastroesophageal reflux disease
  - CVA with long term impairment that is not amendable to rehabilitation or a patient with CVA/transient ischemic attack within past 6 months
  - Obesity with body mass index of  $>30 \text{ kg/m}^2$  may increase surgical risk
  - Chronic liver disease such as Hepatitis B/C/D, or cirrhosis which increases the risk of death from sepsis and hepatic failure requires consultation by a gastroenterologist or hepatologist
  - Gall bladder disease requires ultrasound of the gall bladder with treatment prior to transplantation

#### **Criteria for Hematopoietic Autologous Stem Cell Transplantation:**

2. ***Hematopoietic Autologous stem cell transplantation*** may be authorized **only if** the member has AML in complete first remission (CR-1) **and:** [ALL]
- All pre-transplant criteria are met; and
  - Does not have an allogeneic donor **or** has medical contraindications to an allogeneic transplantation procedure; **and**
  - Is in complete morphologic and cytogenetic complete remission (CR) at the time of stem cell harvest; and
  - Does not have myelodysplastic syndrome (MDS)
  - Should not have any of the absolute contraindications and should be evaluated for any relative contraindications listed above

#### **Criteria for Subsequent Hematopoietic Stem Cell Transplantation:**

3. ***Hematopoietic Allogeneic stem cell transplantation (ablative or non-myeloablative)*** after the first autologous stem cell transplantation has occurred may be authorized only one time for members with AML who meet all of the above criteria for transplant and have any of the following:
- bone marrow relapse: defined as the reappearance of leukemia cells in the bone marrow or peripheral blood after a complete remission as indicated by a peripheral blast count of 5,000 or greater; or
  - primary graft failure indicated by no signs of engraftment\* by 42 days after the transplant; or
  - failure to engraft\*; AND
  - a suitable allogeneic donor has been identified

4. A second or repeat ***Hematopoietic Autologous or Allogeneic stem cell transplantation*** (*ablative or non-myeloablative*) may be authorized only one time for members with AML who meet all of the above criteria for transplant and have any of the following: [ONE]

- primary graft failure indicated by no signs of engraftment\* by 42 days after the transplant; or
- failure to engraft\*

*\*Note: Engraftment is defined as the first 3 consecutive days on which the absolute neutrophil count (ANC) exceeds  $5 \times 10^9/L$  or  $> ANC500$  at any time after transplantation.<sup>15</sup>*

#### CONTINUATION OF THERAPY

When extension of a previously approved transplant authorization is requested, review using updated clinical information is appropriate.

- If Molina Healthcare has authorized prior requests for transplantation, the following information is required for medical review: [ALL]
  - Presence of no absolute contraindication as listed above;
  - History and physical within the last 12 months;
  - Kidney profile within the last 12 months;
  - Cardiac update if history of cardiac disease within two years ( $\geq 50$  years of age);
  - Psychosocial evaluation or update within the last 12 months;
  - Per initial and updated history and physical, any other clinically indicated tests and/or scans as determined by transplant center physician or Molina Medical Director.
- If authorized prior requests for transplantation were obtained from another insurer, the following information is required for medical review: [ALL]
  - Authorization letter/documentation from previous insurer;
  - Presence of no absolute contraindication as listed above;
  - History and physical within the last 12 months;
  - Cardiac update if history of cardiac disease within two years ( $\geq 50$  years of age);
  - Psychosocial evaluation or update within the last 12 months;
  - Per initial and updated history and physical, any other clinically indicated tests and/or scans as determined by transplant center physician or Molina Medical Director.

#### COVERAGE EXCLUSIONS

1. Allogeneic (ablative or non-myeloablative) stem cell transplantation or autologous stem cell transplantation when the above criteria are not met.
2. A second or repeat autologous or allogeneic (ablative or non-myeloablative) transplant due to persistent, progressive or relapsed disease.
3. Hematopoietic stem cell collection, storage and freezing for a future unplanned transplant

**SUMMARY OF MEDICAL EVIDENCE** <sup>4-26</sup>

The published medical evidence and outcomes for hematopoietic stem cell transplantation for acute myelogenous leukemia (AML) in children and adults in the United States consists of registry data obtained from transplant centers that perform adult and pediatric transplantation and is available from the United Network for Organ Sharing (UNOS) database. Registry data demonstrates graft survival rates and outcomes for stem cell transplantation based on demographic and clinical information.

**Professional Society Guidelines:** Several professional society organizations have recommended that Allogeneic SCT is the preferred method of treatment for individuals in first complete remission (CR1) with HLA matched sibling donor, AML after relapse, and second complete remission (CR2). <sup>26-32</sup>

- The NCCN (2019) <sup>32</sup> has outlined risk stratification to guide individual treatment recommendations and prognosis based upon risk status. Transplant indications include intermediate or poor risk stratification.

**CODING INFORMATION** THE CODES LISTED IN THIS POLICY ARE FOR REFERENCE PURPOSES ONLY. LISTING OF A SERVICE OR DEVICE CODE IN THIS POLICY DOES NOT IMPLY THAT THE SERVICE DESCRIBED BY THIS CODE IS COVERED OR NON-COVERED. COVERAGE IS DETERMINED BY THE BENEFIT DOCUMENT. THIS LIST OF CODES MAY NOT BE ALL INCLUSIVE.

CPT	Description
	<b>Collection Codes</b>
38205	Blood-derived hematopoietic progenitor cell harvesting for transplantation, per collection; allogeneic
38206	Blood-derived hematopoietic progenitor cell harvesting for transplantation, per collection; autologous
38230	Bone marrow harvesting for transplantation; allogeneic
38232	Bone marrow harvesting for transplantation; autologous
	<b>Cell Processing Services</b>
38207	Transplant preparation of hematopoietic progenitor cells; cryopreservation and storage
38208	Transplant preparation of hematopoietic progenitor cells; thawing of previously frozen harvest, without washing
38209	Transplant preparation of hematopoietic progenitor cells; thawing of previously frozen harvest, with washing
38210	Transplant preparation of hematopoietic progenitor cells; specific cell depletion within harvest, T-cell depletion
38211	Transplant preparation of hematopoietic progenitor cells; tumor cell depletion
38212	Transplant preparation of hematopoietic progenitor cells; red blood cell removal
38213	Transplant preparation of hematopoietic progenitor cells; platelet depletion
38214	Transplant preparation of hematopoietic progenitor cells; plasma (volume) depletion
38215	Transplant preparation of hematopoietic progenitor cells; cell concentration in plasma, mononuclear, or buffy coat layer
	<b>Cell infusion codes</b>
38240	Bone marrow or blood-derived peripheral stem cell transplantation; allogeneic
38241	Bone marrow or blood-derived peripheral stem cell transplantation; autologous
38242	Bone marrow or blood-derived peripheral stem cell transplantation; allogeneic donor lymphocyte infusions

HCPCS	Description
S2140	Cord blood harvesting for transplantation, allogeneic
S2142	Cord blood derived stem-cell transplantation, allogeneic
S2150	Bone marrow or blood-derived stem cells (peripheral or umbilical), allogeneic or autologous, harvesting, transplantation, and related complications; including pheresis and cell preparation/storage; marrow ablative therapy; drugs; supplies; hospitalization with outpatient follow-up; medical/surgical, diagnostic, emergency, and rehabilitative services; and the number of days of pre-and post-transplant care in the global definition

ICD-10	Description: [For dates of service on or after 10/01/2015]
C92.0- C95.0	Acute myeloid leukemia

## RESOURCE REFERENCES

### Government Agency

- Centers for Medicare & Medicaid Services. NCD for Stem Cell Transplantation (Formerly 110.8.1) 110.23. Effective date 1/27/2016. Accessed at: <http://www.cms.gov/medicare-coverage-database/>
- National Marrow Donor Program. AML Transplant Outcomes. Accessed at: [http://marrow.org/Physicians/When\\_to\\_Transplant/Outcomes\\_by\\_Disease.aspx](http://marrow.org/Physicians/When_to_Transplant/Outcomes_by_Disease.aspx)
- National Bone Marrow Donor Program HLA Matching Requirements. Accessed at: [http://marrow.org/Patient/Transplant\\_Process/Search\\_Process/HLA\\_Matching\\_Finding\\_the\\_Best\\_Donor\\_or\\_Cord\\_Blood\\_Unit.aspx](http://marrow.org/Patient/Transplant_Process/Search_Process/HLA_Matching_Finding_the_Best_Donor_or_Cord_Blood_Unit.aspx)

### Peer Reviewed Publications

- Ashfaq K, Yahaya I et al. Clinical effectiveness and cost-effectiveness of stem cell transplantation in the management of acute leukaemia: a systematic review. *Health Technol Assess.* 2010 Dec;14(54):iii-iv, ix-xi, 1-141.
- Imrie K, Rumble RB, Crump M, Advisory Panel on Bone Marrow and Stem Cell Transplantation, Hematology Disease Site Group. Stem cell transplantation in adults: recommendations. Toronto (ON): Cancer Care Ontario Program in Evidence-based Care; 2009 Jan 30. 78 p. Accessed at: [https://www.cancercare.on.ca/common/pages/UserFile.aspx?serverId=6&path=/File%20Database/CCO%20Files/PEBC/pebc\\_stemcell.pdf](https://www.cancercare.on.ca/common/pages/UserFile.aspx?serverId=6&path=/File%20Database/CCO%20Files/PEBC/pebc_stemcell.pdf)
- C Mackall, T Fry, R Gress, K Peggs, J Storek and A Toubert. Background to hematopoietic cell transplantation, including post-transplant immune recovery. *Bone Marrow Transplant* 44: 457-462; doi:10.1038/bmt.2009.255 Accessed at: <http://www.nature.com/bmt/journal/v44/n8/full/bmt2009255a.html>
- Eastern Cooperative Oncology Group (ECOG) Performance Status. Accessed at: [http://www.ecog.org/general/perf\\_stat.html](http://www.ecog.org/general/perf_stat.html)
- Collins RH, Goldstein S, Giralt S, et al. Donor leukocyte infusions in acute lymphocytic leukemia. *Bone Marrow Transplant.* 2000; 26(5): 511-516. Accessed at: <http://www.nature.com/bmt/journal/v26/n5/full/1702555a.html>
- Mackinnon S. American Society of clinical Oncology (ASCO). Donor Lymphocyte Infusion after Allogeneic Stem Cell Transplantation. 2008. Accessed at: [http://www.asco.org/ascov2/Education+&+Training/Educational+Book?&vmview=edbk\\_detail\\_view&confID=55&abstractID=54](http://www.asco.org/ascov2/Education+&+Training/Educational+Book?&vmview=edbk_detail_view&confID=55&abstractID=54)
- Aoudjhane M, Labopin M et al. Comparative outcome of reduced intensity and myeloablative conditioning regimen in HLA identical sibling allogeneic haematopoietic stem cell transplantation for

- patients older than 50 years of age with acute myeloblastic leukaemia: a retrospective survey from the Acute Leukemia Working Party (ALWP) of the European group for Blood and Marrow transplantation (EBMT). *Leukemia*. 2005 Dec;19(12): 2304-12. Accessed at: [http://www.medicine.ufl.edu/hemonc/fellowship/Reading\\_List/2006\\_2007%20BMT%20ARTICLES/Mini-Transplants/Aoudjhane.pdf](http://www.medicine.ufl.edu/hemonc/fellowship/Reading_List/2006_2007%20BMT%20ARTICLES/Mini-Transplants/Aoudjhane.pdf)
11. Cornelisson JJ, van Putten WL et al. Results of a HOVON/SAKK donor versus no-donor analysis of myeloablative HLA-identical sibling stem cell transplantation in first remission acute myeloid leukemia in young and middle-aged adults: benefits for whom? *Blood*. 2007 May 1;109(9):3658-66. Epub 2007 Jan 9. Accessed at: <http://bloodjournal.hematologylibrary.org/content/109/9/3658.full.pdf>
  12. Ravindranath Y, Chang M. et al. Pediatric Oncology Group (POG) studies of acute myeloid leukemia (AML): a review of four consecutive childhood AML trials conducted between 1981 and 2000. *Leukemia*. 2005 Dec; 19(12):2101-16. Accessed at: <http://www.nature.com/leu/journal/v19/n12/full/2403927a.html>
  13. Yanada, M, Matsuo, K, Emi, N, Naoe, T. Efficacy of allogeneic hematopoietic stem cell transplantation depends on cytogenetic risk for acute myeloid leukemia in first disease remission: a meta analysis. *Cancer*. 2005 Apr 15;103(8):1652-8. PMID: 15742336
  14. Koreth, J, Schlenk, R, Kopecky, KJ, et al. Allogeneic stem cell transplantation for acute myeloid leukemia in first complete remission: systematic review and meta-analysis of prospective clinical trials. *JAMA*. 2009 Jun 10;301(22):2349-61. PMID: 19509382
  15. National Bone Marrow Donor Program. Measuring Engraftment. Accessed at: [http://marrow.org/Patient/Transplant\\_Process/Days\\_0-30/Measuring\\_Engraftment.aspx](http://marrow.org/Patient/Transplant_Process/Days_0-30/Measuring_Engraftment.aspx)
  16. Thakar MS, Forman SJ. ASH evidence-based guidelines: is there a role for second allogeneic transplant after relapse? *Hematology Am Soc Hematol Educ Program*. 2009:414-8. Accessed at: <http://asheducationbook.hematologylibrary.org/content/2009/1/414.long>
  17. Blau IW, Basara N et al. Second allogeneic hematopoietic stem cell transplantation as treatment for leukemia relapsing following a first transplant. *Bone Marrow Transplant*. 2000 Jan; 25(1):41-5.
  18. Michallet M, Tanguy ML et al. Second allogeneic haematopoietic stem cell transplantation in relapsed acute and chronic leukaemias for patients who underwent a first allogeneic bone marrow transplantation: a survey of the Société Française de Greffe de moelle (SFGM). *Bone Marrow Transplant*. 2000 Jan;25(1):41-5.
  19. Wang, J, Ouyang, J, Zhou et al. Autologous hematopoietic stem cell transplantation for acute myeloid leukemia in first complete remission: a meta-analysis of randomized trials. *Acta Haematol*. 2010;124(2):61-71. PMID: 20616541
  20. Klusmann JH, Reinhardt D, Zimmermann M et al. The role of matched sibling donor allogeneic stem cell transplantation in pediatric high-risk acute myeloid leukemia: results from the AML-BFM 98 study. *Haematologica*. 2012 Jan; 97(1):21-9. Epub 2011 Sep 20.
  21. Bejanyan N, Weisdorf DJ, Logan BR, et al. Survival of patients with acute myeloid leukemia relapsing after allogeneic hematopoietic cell transplantation: a center for international blood and marrow transplant research study. *Biol Blood Marrow Transplant*. 2015; 21(3):454-459.
  22. Heidrich, K, Thiede, C, Schafer-Eckart, K, et al. Allogeneic hematopoietic cell transplantation in intermediate risk acute myeloid leukemia negative for FLT3-ITD, NPM1- or biallelic CEBPA mutations. *Annals of oncology : official journal of the European Society for Medical Oncology*. 2017 Nov 1;28(11):2793-8. PMID: 28945881
  23. Canaani, J, Labopin, M, Socie, G, et al. Long term impact of hyperleukocytosis in newly diagnosed acute myeloid leukemia patients undergoing allogeneic stem cell transplantation: An analysis from the acute leukemia working party of the EBMT. *American journal of hematology*. 2017 Jul;92(7):653-9. PMID: 28370339

24. Alloin L-F, Leverger G, Dalle J-H, et al. Cytogenetics and outcome of allogeneic transplantation in first remission of acute myeloid leukemia: the French pediatric experience. *Bone Marrow Transplant*. 2017; 52(4): 516-521
25. Döhner H, Estey E, Grimwade D, et al. Diagnosis and management of AML in adults: 2017 ELN recommendations from an international expert panel. *Blood*. 2017; 129(4): 424-447
26. Brissot E, Labopin L et al. Haploidentical versus unrelated allogeneic stem cell transplantation for relapsed/refractory acute myeloid leukemia: a report on 1578 patients from the Acute Leukemia Working Party of the EBMT. *Haematologica*. 2019 Mar; 104(3): 524–532. Accessed at: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6395335/>

### Professional Society Guidelines

27. National Marrow Donor Program® (NMDP) and the American Society for Blood and Marrow Transplantation (ASBMT) referral guidelines: Recommended Timing for Transplant Consultation. Accessed at: <https://bethematchclinical.org/Transplant-Indications-and-Outcomes/Referral-Timing-Guidelines/>
28. The American Society for Blood and Marrow Transplantation (ASBMT). The Role of Cytotoxic Therapy with Hematopoietic Stem Cell Transplantation in the Therapy of Adult Acute Myeloid Leukemia in Adults: *Biol Blood Marrow Transplant*. 2008; 14:135-136.
29. The American Society for Blood and Marrow Transplantation (ASBMT). The Role of Cytotoxic Therapy with Hematopoietic Stem Cell Transplantation in the Therapy of Acute Myeloid Leukemia in Children. *Biology of Blood and Marrow Transplantation* 2007;13:500-501. Accessed at: <http://www.asbmt.org/?page=GuidelineStatements>
30. National Marrow Donor Program® (NMDP). Patient Eligibility for HCT. Accessed at: <https://bethematchclinical.org/Transplant-Indications-and-Outcomes/Eligibility/>
31. National Cancer Institute. Adult Acute Myeloid Leukemia PDQ 2019. Accessed at: <http://www.cancer.gov/types/leukemia/patient/adult-aml-treatment-pdq>
32. National Cancer Institute. Childhood Acute Myeloid Leukemia PDQ 2019. Accessed at: <http://www.cancer.gov/types/leukemia/patient/adult-aml-treatment-pdq>
33. National Comprehensive Cancer Network (NCCN) Clinical Practice Guidelines in Oncology Acute Myeloid Leukemia. Version 2.2020 Accessed at: [http://www.nccn.org/professionals/physician\\_gls/f\\_guidelines.asp](http://www.nccn.org/professionals/physician_gls/f_guidelines.asp)

### Other Resources

34. McKesson InterQual Criteria for Procedures: Adult 2018 InterQual Transplantation, Allogeneic Stem Cell, Autologous Stem Cell; 2018.
35. DynaMed LLC [website]. EBSCO Publishing 1998-2019. Acute Myeloid Leukemia.
36. UpToDate. [website]. Waltham, MA: Walters Kluwer Health; 2019.
  - Larson R. Treatment of relapsed or refractory acute myeloid leukemia.
  - Holmberg L, Deeg H, Sandmaier B. Determining eligibility for autologous hematopoietic cell transplantation.
  - Larson R. Post Remission Therapy for Acute Myeloid Leukemia in Younger Adults.
  - Deeg H, Sandmaier B. Determining eligibility for allogeneic hematopoietic cell transplantation.
  - Chao NG. Selection of an umbilical cord blood graft for hematopoietic cell transplantation.
  - Fuchs E, Luznik L. HLA-haploidentical hematopoietic cell transplantation.
37. Advanced Medical Review (AMR):
  - Policy reviewed by MD board certified in Internal Medicine, Oncology & Hematology. 10/19/12

- Policy reviewed by MD board certified in Internal Medicine, Oncology & Hematology. 4/2/19

### **Review/Revision History**

10/31/12: Policy created

9/1/15: The policy was reviewed and updated with revisions made to the pre-transplant criteria, minor revision to the criteria, guideline and reference sections were updated.

12/14/16, 6/22/17: Policy reviewed, no changes

9/13/18: Policy reviewed, no criteria changes. Updated references.

6/19/19: Policy reviewed, no changes to criteria. Updated risk stratification table based on NCCN 2019 guidelines, updated references. Criteria and summary of medical evidence sections condensed for ease of application. Moved risk stratification table to criteria section.

12/10/19: Clarified that haploidentical transplants may be considered medically necessary when there are no matched sibling or unrelated donors.