Hematopoietic Cell Transplantation for Non-Hodgkin Lymphomas

I. Description

Hematopoietic cell transplantation (HCT) refers to a procedure in which hematopoietic stem cells are infused to restore bone marrow function in cancer patients who receive bone-marrow-toxic doses of cytotoxic drugs, with or without whole-body radiation therapy. Hematopoietic stem cells may be obtained from the transplant recipient (autologous HCT) or from a donor (allogeneic HCT). They can be harvested from bone marrow, peripheral blood, or umbilical cord blood shortly after delivery of neonates. Although cord blood is an allogeneic source, the stem cells in it are antigenically “naïve” and thus are associated with a lower incidence of rejection or graft-versus-host disease (GVHD).

Randomized trials have shown no survival advantage to HCT as first-line therapy for indolent B-cell lymphomas; however, randomized studies have shown a survival benefit for relapsed disease.

Data from randomized trials have shown conflicting results, but some have shown an overall survival (OS) benefit with HCT to consolidate a first complete remission (CR) in patients with aggressive B-cell lymphomas at high or high-intermediate risk of relapse. Randomized studies of HCT for relapsed aggressive B-cell lymphomas have shown an overall survival benefit with this approach.

No randomized studies have been conducted on the use of tandem HCT for the treatment of non-Hodgkin lymphoma (NHL), and the published evidence comprises small numbers of patients. Therefore, the data on tandem transplants are insufficient to determine outcomes with this type of treatment.

Due in part to the relative rarity of the disease, randomized studies on the use of HCT in mantle cell lymphoma (MCL) have not been conducted. Case series have shown long-term disease control of
this aggressive lymphoma with the use of autologous HCT (with rituximab) to consolidate a first remission; however, the use of autologous HCT in the relapsed setting has not shown improved outcomes. Allogeneic HCT has shown prolonged disease control in the relapsed/refractory setting.

The role of HCT in peripheral T-cell lymphoma (PTCL) is not well-defined. Few studies have been conducted, many of these retrospectively, with small numbers of patients and heterogeneous patient populations including good- and poor-risk patients in the same study. This is partly due to the rarity and heterogeneity of this group of lymphomas. In particular, studies often mix patients with PTCL-NOS (NOS [not otherwise specified], which has a poorer prognosis) with patients with anaplastic lymphoma kinase-anaplastic large-cell lymphomas (ALK + ALCL), which has a better prognosis (even with conventional chemotherapy regimens), and ALK - ALCL patients who have a worse prognosis than ALK + ALCL but better than PTCL-NOS patients. There have been no randomized studies comparing chemotherapy regimens solely in patients with PTCL (ie, some randomized studies have included PTCL with aggressive B-cell lymphomas). For frontline therapy, results from recent phase II studies with autologous HCT as consolidation offers the best survival outcomes for patients with high-risk features; randomized trials to confirm this have not been performed. No relevant data for the use of allogeneic HCT in the front-line setting are available. Patients with relapsed or refractory PTCL are generally considered incurable with chemotherapy alone. In the salvage setting, data show that the use of HCT may improve survival outcomes similar to the results seen in corresponding aggressive B-cell lymphomas in the same treatment setting.

II. Policy

A. For patients with NHL B-cell subtypes considered aggressive (except mantle cell lymphoma), either allogeneic hematopoietic stem-cell transplant (HCT) using a myeloablative conditioning regimen or autologous HCT is covered (subject to Limitations/Exclusions and Administrative Guidelines) for the following:
   1. as salvage therapy for patients who do not achieve a complete remission (CR) after first-line treatment (induction) with a full course of standard-dose chemotherapy;
   2. to achieve or consolidate a CR for those in a chemo-sensitive first or subsequent relapse; or
   3. To consolidate a first CR in patients with diffuse large B-cell lymphoma, with an age-adjusted International Prognostic Index score that predicts a high- or high-intermediate risk of relapse.

B. For patients with mantle cell lymphoma:
   1. Autologous HCT is covered (subject to Limitations/Exclusions and Administrative Guidelines) to consolidate a first remission.
   2. Allogeneic HCT, myeloablative or reduced-intensity conditioning is covered (subject to Limitations/Exclusions and Administrative Guidelines) as salvage therapy.

C. For patients with NHL B-cell subtypes considered indolent, either allogeneic HCT using a myeloablative conditioning regimen or autologous HCT is covered (subject to Limitations/Exclusions and Administrative Guidelines) for the following:
   1. As salvage therapy for patients who do not achieve CR after first-line treatment (induction) with a full course of standard-dose chemotherapy; or
2. To achieve or consolidate CR for those in a first or subsequent chemosensitive relapse, whether or not their lymphoma has undergone transformation to a higher grade.

D. For patients with mature T-cell or NK-cell (peripheral T-cell) neoplasms:
   1. Autologous HCT is covered (subject to Limitations/Exclusions and Administrative Guidelines) to consolidate a first complete remission in high-risk subtypes. (see Policy Guidelines)
   2. Autologous or allogeneic HCT (myeloablative or reduced-intensity conditioning) is covered (subject to Limitations/Exclusions and Administrative Guidelines) as salvage therapy.

E. Reduced-intensity conditioning (RIC) allogeneic HCT is covered (subject to Limitations/Exclusions and Administrative Guidelines) as a treatment of NHL in patients who meet criteria for an allogeneic HCT but who do not qualify for a myeloablative allogeneic HCT (see Policy Guidelines).

III. Policy Guidelines
   A. RIC would be considered an option in patients who meet criteria for an allogeneic HCT but whose age (typically older than 55 years) or comorbidities (e.g., liver or kidney dysfunction, generalized debilitation, prior intensive chemotherapy) preclude use of a standard conditioning regimen.

   B. In patients who qualify for a myeloablative allogeneic hematopoietic HCT on the basis of overall health and disease status, allogeneic HCT using either myeloablative or RIC may be considered. However, a myeloablative conditioning regimen with allogeneic HCT may benefit younger patients with good performance status and minimal comorbidities more than allogeneic HCT with RIC.

   C. The term salvage therapy describes therapy given to patients who have either 1) failed to achieve complete remission after initial treatment for newly diagnosed lymphoma, or 2) relapsed after an initial complete remission.

   D. A chemosensitive relapse is defined as relapsed NHL that does not progress during or immediately after standard-dose induction chemotherapy (i.e., achieves stable disease or a partial response).

   E. Transformation describes a lymphoma whose histologic pattern has evolved to a higher-grade lymphoma. Transformed lymphomas typically evolve from a nodular pattern to a diffuse pattern.

   F. Tandem transplants usually are defined as the planned administration of 2 successive cycles of high-dose myeloablative chemotherapy, each followed by infusion of autologous hematopoietic stem cells, whether or not there is evidence of persistent disease following the first treatment cycle. Sometimes, the second cycle may use non-myeloablative immunosuppressive conditioning followed by infusion of allogeneic stem cells.

High risk (aggressive) T-cell and NK-cell neoplasms
The T-cell and NK-cell neoplasms are a clinically heterogeneous group of rare disorders, most of which have an aggressive clinical course and poor prognosis. The exception would include the following subtypes which typically have a relatively indolent and protracted course:

- T-cell large granulocyte leukemia (T-LGL)
- chronic lymphoproliferative disorder of NK cells
- early stage mycosis fungoides
- primary cutaneous ALCL, and ALK+ ALCL

IV. Limitations/Exclusions

A. For patients with mantle cell lymphoma:
   1. Autologous HCT is not covered as salvage therapy as it is not known to be effective in improving health outcomes.
   2. Allogeneic HCT is not covered to consolidate a first remission as it is not known to be effective in improving health outcomes.

B. Either autologous HCT or allogeneic HCT is not covered for any one of the following as they are not known to be effective in improving health outcomes:
   1. As initial therapy (i.e., without a full course of standard-dose induction chemotherapy) for any NHL;
   2. To consolidate a first CR for patients with diffuse large B-cell lymphoma and an International Prognostic Index score that predicts a low- or low-intermediate risk of relapse;
   3. To consolidate a first CR for those with indolent NHL B-cell subtypes;

C. For patients with mature T-cell or NK cell (peripheral T-cell) lymphoma:
   1. Allogeneic HCT to consolidate a first remission is not covered as it is not known to be effective in improving health outcomes.

D. Tandem transplants are not covered to treat patients with any stage, grade, or sub-type of NHL as they are not known to be effective in improving health outcomes

V. Administrative Guidelines

Precertification is required for a transplant evaluation and for the transplant itself and should be submitted by the proposed treating facility. To precertify, please complete HMSA's Precertification Request and mail or fax the form, or use iExchange as indicated along with the required documentation.

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<td>G0266</td>
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ICD-10 codes are provided for your information. These will not become effective until 10/01/2015

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VI. Background

HCTHematopoietic cell transplantation (HCT) refers to a procedure in which hematopoietic stem cells are infused to restore bone marrow function in cancer patients who receive bone-marrow-toxic doses of cytotoxic drugs, with or without whole-body radiation therapy. Hematopoietic stem cells may be obtained from the transplant recipient (autologous HCT) or from a donor (allogeneic HCT). They can be harvested from bone marrow, peripheral blood, or umbilical cord blood shortly after delivery of neonates. Although cord blood is an allogeneic source, the stem cells in it are antigenically “naïve” and thus are associated with a lower incidence of rejection or graft-versus-host disease (GVHD).

Conventional Preparative Conditioning for Hematopoietic SCT
The success of autologous HCT is predicated on the ability of cytotoxic chemotherapy with or without radiation to eradicate cancerous cells from the blood and bone marrow. This permits subsequent engraftment and repopulation of bone marrow space with presumably normal hematopoietic stem cells obtained from the patient prior to undergoing bone marrow ablation. As a consequence, autologous HCT is typically performed as consolidation therapy when the patient’s disease is in complete remission. Patients who undergo autologous HCT are susceptible to chemotherapy-related toxicities and opportunistic infections prior to engraftment, but not GVHD.

The conventional (“classical”) practice of allogeneic HCT involves administration of cytotoxic agents (e.g., cyclophosphamide, busulfan) with or without total-body irradiation at doses sufficient to destroy endogenous hematopoietic capability in the recipient. The beneficial treatment effect in this procedure is due to a combination of initial eradication of malignant cells and subsequent graft-versus-malignancy (GVM) effect mediated by nonself immunologic effector cells that develop after engraftment of allogeneic stem cells within the patient’s bone marrow space. While the slower GVM effect is considered to be the potentially curative component, it may be overwhelmed by extant disease without the use of pretransplant conditioning. However, intense conditioning regimens are limited to patients who are sufficiently fit medically to tolerate substantial adverse effects that include pre-engraftment opportunistic infections secondary to loss of endogenous bone marrow function and organ damage and failure caused by the cytotoxic drugs. Furthermore, in any allogeneic HCT, immune suppressant drugs are required to minimize graft rejection and GVHD, which also increases susceptibility of the patient to opportunistic infections.

**RIC for Allogeneic HCT**

RIC refers to the pretransplant use of lower doses or less intense regimens of cytotoxic drugs or radiation than are used in traditional full-dose myeloablative conditioning treatments. The goal of RIC is to reduce disease burden but also to minimize as much as possible associated treatment-related morbidity and nonrelapse mortality (NRM) in the period during which the beneficial GVM effect of allogeneic transplantation develops. Although the definition of RIC remains arbitrary, with numerous versions employed, all seek to balance the competing effects of NRM and relapse due to residual disease. RIC regimens can be viewed as a continuum in effects, from nearly totally myeloablative to minimally myeloablative with lymphoablation, with intensity tailored to specific diseases and patient condition. Patients who undergo RIC with allogeneic HCT initially demonstrate donor cell engraftment and bone marrow mixed chimerism. Most will subsequently convert to full-donor chimerism, which may be supplemented with donor lymphocyte infusions to eradicate residual malignant cells.

For the purposes of this Policy, the term “reduced-intensity conditioning” will refer to all conditioning regimens intended to be nonmyeloablative, as opposed to fully myeloablative (traditional) regimens.

**Non-Hodgkin Lymphoma (NHL)**

A heterogeneous group of lymphoproliferative malignancies, NHL usually originates in lymphoid tissue. Historically, uniform treatment of patients with NHL was hampered by the lack of a uniform
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classification system. In 1982, the Working Formulation (WF) was developed to unify different classification systems into one. The WF divided NHL into low-, intermediate-, and high-grade, with subgroups based on histologic cell type. Since our understanding of NHL has improved, the diagnosis has become more sophisticated and includes the incorporation of new immunophenotyping and genetic techniques. As a result, the WF has become outdated.

European and American pathologists proposed a new classification, the Revised European-American Lymphoma (REAL) Classification and an updated version of the REAL system, the new World Health Organization (WHO) classification. The WHO/REAL classification recognized 3 major categories of lymphoid malignancies based on morphology and cell lineage: B-cell neoplasms, T-cell/natural killer (NK)-cell neoplasms, and Hodgkin lymphoma.

The most recent lymphoma classification is the 2008 WHO classification:

**Updated WHO Classification 2008**

**Mature B-cell neoplasms**

- Chronic lymphocytic leukemia/small lymphocytic lymphoma
- B-cell prolymphocytic leukemia
- Splenic marginal zone lymphoma
- Hairy cell leukemia
- *Splenic lymphoma/leukemia, unclassifiable*
  - *Splenic diffuse red pulp small B-cell lymphoma*
  - *Hairy cell leukemia-variant*
- Lymphoplasmacytic lymphoma
  - Waldenstrom macroglobulinemia
- Heavy chain diseases
  - Alpha heavy chain disease
  - Gamma heavy chain disease
  - Mu heavy chain disease
- Plasma cell myeloma
- Solitary plasmacytoma of bone
- Extraosseous plasmacytoma
- Extranodal marginal zone B-cell lymphoma of mucosa-associated lymphoid tissue (MALT lymphoma)
- Nodal marginal zone B-cell lymphoma (MZL)
  - *Pediatric type nodal MZL*
- Follicular lymphoma
  - Pediatric type follicular lymphoma
- Primary cutaneous follicle center lymphoma
- Mantle cell lymphoma
- Diffuse large B-cell lymphoma (DLBCL), not otherwise specified
  - T cell/histiocyte rich large B-cell lymphoma
  - *DLBCL associated with chronic inflammation*
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- Epstein-Barr virus (EBV)+ DLBCL of the elderly
  - Lymphomatoid granulomatosis
  - Primary mediastinal (thymic) large B-cell lymphoma
  - Intravascular large B-cell lymphoma
  - Primary cutaneous DLBCL, leg type
  - ALK [anaplastic lymphoma kinase] + large B-cell lymphoma
  - Plasmablastic lymphoma
  - Primary effusion lymphoma
  - Large B-cell lymphoma arising in HHV8-associated multicentric Castleman disease
  - Burkitt lymphoma
  - B-cell lymphoma, unclassifiable, with features intermediate between diffuse large B-cell lymphoma and Burkitt lymphoma
  - B-cell lymphoma, unclassifiable, with features intermediate between diffuse large B-cell lymphoma and classical Hodgkin lymphoma

*These represent provisional entities or provisional subtypes of other neoplasms.

Diseases shown in *italics* are newly included in the 2008 WHO classification.

**Mature T-cell and NK-cell neoplasms**

- T-cell prolymphocytic leukemia
- T-cell large granular lymphocytic leukemia
- Chronic lymphoproliferative disorder of NK-cells*
- Aggressive NK-cell leukemia
- Systemic EBV [Epstein-Bar virus]+ T-cell lymphoproliferative disease of childhood (associated with chronic active EBV infection)
- Hydroa vacciniforme-like lymphoma
- Adult T-cell leukemia/ lymphoma
- Extranodal NK/T cell lymphoma, nasal type
- Enteropathy-associated T-cell lymphoma
- Hepatosplenic T-cell lymphoma
- Subcutaneous panniculitis-like T-cell lymphoma
- Mycosis fungoides
- Sézary syndrome
- Primary cutaneous CD30+ T-cell lymphoproliferative disorder
  - Lymphomatoid papulosis
  - Primary cutaneous anaplastic large-cell lymphoma
- Primary cutaneous aggressive epidermotropic CD8+ cytotoxic T-cell lymphoma*
- Primary cutaneous gamma-delta T-cell lymphoma
- Primary cutaneous small/medium CD4+ T-cell lymphoma*
- Peripheral T-cell lymphoma, not otherwise specified
- Angioimmunoblastic T-cell lymphoma
- Anaplastic large cell lymphoma (ALCL), ALK+  
- **Anaplastic large cell lymphoma (ALCL), ALK−**
*These represent provisional entities or provisional subtypes of other neoplasms.

Diseases shown in *italics* are newly included in the 2008 WHO classification.

In the U.S., B-cell lymphomas represent 80%–85% of cases of NHL, and T-cell lymphomas represent 15%–20%. NK lymphomas are relatively rare.

The International Lymphoma Classification Project identified the most common NHL subtypes as follows: diffuse large B-cell lymphoma (DLBCL) 31%, follicular lymphoma (FL) 22%, small lymphocytic lymphoma/chronic lymphocytic leukemia (SLL/CLL) 6%, mantle cell lymphoma (MCL) 6%, peripheral T-cell lymphoma (PTCL) 6%, and marginal zone B-cell lymphoma/ MALT lymphoma 5%. All other subtypes each represent less than 2% of cases of NHL.

In general, the NHL can be divided into two prognostic groups, indolent and aggressive. Indolent NHL has a relatively good prognosis, with a median survival of 10 years; however, it is not curable in advanced clinical stages. Early stage indolent NHL (stage 1 or 2) may be effectively treated with radiation alone. Although indolent NHL is responsive to radiation and chemotherapy, a continuous rate of relapse is seen in advanced stages. These patients can often be re-treated if their disease remains of the indolent type. Indolent NHL may transform into a more aggressive form, which is generally treated with regimens that are used for aggressive, recurrent NHL. Histologic transformation to higher grade lymphoma occurs in up to 70% of patients with low-grade lymphoma, and median survival with conventional chemotherapy is 1 year or less.

FL is the most common indolent NHL (70%–80% of cases), and often the terms indolent lymphoma and FL are used synonymously. Also included in the indolent NHL are SLL/CLL, lymphoplasmacytic lymphoma, marginal zone lymphomas, and cutaneous T-cell lymphoma.

Aggressive NHL has a shorter natural history; however, 30%–60% of these patients can be cured with intensive combination chemotherapy regimens. Aggressive lymphomas include DLBCL, MCL, PTCL, anaplastic large cell lymphoma, and Burkitt lymphoma.

Oncologists developed a clinical tool to aid in predicting the prognosis of patients with aggressive NHL (specifically DLBCL), referred to as the International Prognostic Index (IPI). Prior to the development of IPI in 1993, prognosis was predominantly based on disease stage.

Based on the number of risk factors present and adjusted for patient age, the IPI defines 4 risk groups: low, low intermediate, high intermediate, and high risk, based on 5 significant risk factors prognostic of overall survival (OS):

1. Age older than 60 years
2. Elevated serum lactate dehydrogenase (LDH) level
3. Ann Arbor stage III or IV disease
4. Eastern Cooperative Oncology Group (ECOG) performance status of 2, 3, or 4
5. Involvement of more than 1 extranodal site
Risk groups are stratified according to the number of adverse factors as follows: 0 or 1 is low risk, 2 is low intermediate, 3 is high intermediate, and 4 or 5 are high risk.

Patients with 2 or more risk factors have a less than 50% chance of relapse-free survival (RFS) and OS at 5 years. Age-adjusted (aaIPI) and stage-adjusted modifications of this IPI are used for younger patients with localized disease.

Adverse risk factors for age-adjusted IPI include stage III or IV disease, elevated LDH and ECOG performance status of 2 or greater and can be calculated as follows: 0 is low risk, 1 is low intermediate, 2 is high intermediate, and 3 is high risk.

With the success of the IPI, a separate prognostic index was developed for FL, which has multiple independent risk factors for relapse after a first complete remission. The proposed and validated Follicular Lymphoma International Prognostic Index (FLIPI) contains 5 adverse prognostic factors:

1. Age older than 60 years
2. Ann Arbor stage III–IV
3. Hemoglobin level less than 12.0 g/dL
4. More than 4 lymph node areas involved
5. Elevated serum lactate dehydrogenase (LDH) level

These 5 factors are used to stratify patients into 3 categories of risk: low (0–1 risk factor), intermediate (2 risk factors), or poor (3 or more risk factors).

Mantle Cell Lymphoma (MCL)

MCL comprises approximately 65–8% of NHL and has been recognized within the past 15 years as a unique lymphoma subtype with a particularly aggressive course. MCL is characterized by a chromosomal translocation t, and the term mantle cell lymphoma was proposed in 1992 by Banks et al. The number of therapeutic trials are not as numerous for MCL as for other NHL, as it was not widely recognized until the REAL classification. MCL shows a strong predilection for elderly men, and the majority of cases (70%) present with disseminated (stage 4) disease and extranodal involvement is common. Localized MCL is quite rare. MCL has a median survival of approximately 2–4 years, and although most patients achieve remission with first-line therapy, relapse inevitably occurs, often within 12–18 months. MCL is rarely, if ever, cured with conventional therapy, and no standardized therapeutic approach to MCL is used.

There had been no generally established prognostic index for patients with MCL. Application of the IPI or FLIPI system to patients with MCL showed limitations, which included no separation of some important risk groups. In addition, some of the individual IPI and FLIPI risk factors, including number of extranodal sites and number of involved nodal areas showed no prognostic relevance, and hemoglobin showed no independent prognostic relevance in patients with MCL. Therefore, a new prognostic index for patients with MCL was developed and should prove useful in comparing clinical trial results for MCL.
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**MCL international prognostic index**

1. **Age**
2. **ECOG performance status**
3. **Serum LDH** (calculated as a ratio of LDH to a laboratory’s upper limit of normal)
4. **White blood cell count (WBC)**
   - Zero points each are assigned for age younger than 50 years, ECOG performance 0–1, LDH ratio less than 0.67, WBC less than 6,700
   - One point each for age 50–59 years, LDH ratio 0.67–0.99, WBC 6,700–9,999
   - Two points each for age 60–69 years, ECOG 2–4, LDH ratio 1.00–1.49, WBC 10,000–14,999
   - Three points each for age 70 years or older, LDH ratio 1.5 or greater, WBC 15,000 or more

**MIPI allows separation of 3 groups with significantly different prognoses:**

- 0–3 points=low risk, 44% of patients, median OS not reached and a 5-year OS rate of 60%
- 4–5 points=intermediate risk, 35% of patients, median OS 51 months
- 6–11 points=high risk, 21% of patients, median OS 29 months

**Peripheral T-Cell Lymphoma**

The majority of peripheral T-cell lymphomas are aggressive and fall into the category of PTCL, unspecified (PTCL-u) or not otherwise specified (PTCL-NOS), angioimmunoblastic or anaplastic large cell which, combined make up approximately 60%–70% of T-cell lymphomas. PTCLs are less responsive to standard chemotherapy than DLBCLs and carry a worse prognosis than aggressive B cell counterparts. Survival rates at 5 years with standard chemotherapy regimens range from 20%–35%. The poor results with conventional chemotherapy have prompted exploration of the role of HCT as therapy.

**Staging**

The Ann Arbor staging classification is commonly used for the staging of lymphomas and is the scheme defined in the American Joint Committee on Cancer (AJCC) Manual for Staging Cancer. Originally developed for Hodgkin's disease, this staging scheme was later expanded to include non-Hodgkin lymphoma.

**Ann Arbor Classification**

**Stage I**
Involvement of a single lymph node region (I) or of a single extralymphatic organ or site (IE)

**Stage II**
Involvement of 2 or more lymph node regions on the same side of the diaphragm (II) or localized involvement of extralymphatic organ or site and of one or more lymph node regions on the same side of the diaphragm (IIE).
Stage III
Involvement of lymph node regions on both sides of the diaphragm (III) which may also be accompanied by localized involvement of extralymphatic organ or site (IIIE) or by involvement of the spleen (IIIS) or both (IIISE)

Stage IV
Diffuse or disseminated involvement of one or more extralymphatic organs or tissues with or without associated lymph node enlargement.

VII. Rationale
This policy was initially based on 4 TEC Assessments. Since that time, the classification of NHL has undergone significant changes, and several new and unique subtypes have emerged (eg, MCL, PTCL).

The policy has been updated regularly based on a search of the National Library of Medicine PubMed database, most recently through November 25, 2014. Following is a summary of key literature to date.

Indolent Lymphomas

Hematopoietic Stem Cell Transplantation as First-Line Treatment for Indolent NHL
In 2012, Al Khabori et al performed a systematic review and meta-analysis of the use of autologous HCT in untreated, advanced FL. Four randomized controlled trials (RCTs) comparing autologous HCT to conventional chemotherapy in 941 patients were included. Three trials reported overall survival (OS); moderate quality evidence from these trials did not show an improved OS with the use of HCT as part of the initial treatment of FL. Adverse outcomes including treatment-related mortality and the development of myelodysplastic syndrome, acute myeloid leukemia, and solid tumors, were not different between the 2 arms.

In 2012, Schaaf et al performed a systematic review with meta-analysis of RCTs comparing autologous HCT with chemotherapy or immunochemotherapy in patients with previously untreated or relapsed FL with respect to OS, progression-free survival (PFS), treatment-related mortality, adverse events and secondary malignancies. Five RCTs involving 1093 patients were included; 4 trials in previously untreated patients and 1 trial in relapsed patients. The quality of the 5 trials was judged to be moderate. There was a statistically significant increase in PFS in previously untreated FL patients in the HCT arm (hazard ratio [HR]=0.42 (95% confidence interval [CI], 0.33 to 0.54; p<0.0001). However, there was not a statistically significant OS advantage (HR=0.97; 95% 0.76 to 1.24; p=0.81). In the 4 trials in previously untreated patients, there were no statistically significant differences between HCT and the control-arm in terms of treatment-related mortality (risk ratio [RR]=1.28; 95% CI, 0.25 to 6.61; p=0.77), secondary acute myeloid leukemia/myelodysplastic syndromes (RR=2.87; 95% CI, 0.7 to 11.75; p=0.14) or solid cancers (RR=1.20; 95% CI, 0.25 to 5.77; p=0.82). Adverse events were rarely reported and were more frequent in patients who underwent HCT. For patients with relapsed FL, there was some evidence from one trial with 70 patients that HCT was advantageous in terms of PFS and OS (PFS: HR=0.30;
95% CI, 0.15 to 0.61; OS: HR=0.40; 95% CI, 0.18 to 0.89). No results were reported from this trial for treatment-related mortality, adverse events, or secondary cancers.

In 2008, Ladetto et al reported the results of a Phase III, randomized, multicenter trial of patients with high-risk FL, treated at diagnosis. A total of 134 patients were enrolled to receive either rituximab-supplemented high-dose chemotherapy and autologous HCT or 6 courses of cyclophosphamide, doxorubicin (or Adriamycin®), vincristine (Oncovin®), and prednisolone (CHOP) followed by rituximab (CHOP-R). Of these patients, 79% completed HCT and 71% completed CHOP-R. Complete remission was 85% with HCT and 62% with CHOP-R. At a median follow-up of 51 months, the 4-year event-free survival (EFS) was 61% and 28% (HCT vs CHOP-R, respectively), with no difference in OS. Molecular remission (defined as negative results by polymerase chain reaction (PCR) on 2 or more consecutive bone marrow samples spaced 6 months apart in patients who reached CR was achieved in 80% of HCT and 44% of CHOP-R patients and was the strongest independent outcome predictor. In 71% of the CHOP-R patients who had a relapse, salvage HCT was performed and achieved an 85% CR rate and a 68% 3-year EFS.

In 2006, Sebban et al reported the results of a randomized, multicenter study. (19) A total of 209 patients received cyclophosphamide, Adriamycin, etoposide, prednisolone (CHVP) plus interferon (CHVP-I arm), and 131 patients received CHOP followed by high-dose chemotherapy with total-body irradiation and autologous HCT. Response rates were similar in both groups (79% and 78% after induction therapy, respectively). After a median follow-up of 7.5 years, intention-to-treat analysis (ITT) showed no difference between the 2 arms for OS (p=0.53) or EFS (p=0.11).

Deconinck and colleagues investigated the role of autologous HCT as initial therapy in 172 patients with FL considered at high risk due to the presence of either B symptoms (i.e., weight loss, fever, or night sweats), a single lymph node larger than 7 cm, more than 3 involved nodal sites, massive splenomegaly, or a variety of other indicators of high tumor burden. The patients were randomized to receive either an immunochemotherapy regimen or a high-dose therapy followed by purged autologous HCT. While the autologous HCT group had a higher response rate and longer median EFS, there was no significant improvement in OS rate due to an excess of secondary malignancies.

In 2004, Lenz and colleagues reported on the results of a trial of 307 patients with advanced stage lymphoma in first remission, including FL, MCL, or lymphoplasmacytoid lymphoma. Patients were randomized to receive either consolidative therapy with autologous HCT or interferon therapy. The 5-year PFS rate was considerably higher in the autologous HCT arm (64.7%) compared with the interferon arm (33.3%). However, the median follow-up of patients in this study was too short to allow any comparison of OS.

**HCT for Relapsed, Indolent NHL**

In the majority of patients with FL relapse, and with relapsed disease, cure is very unlikely, with a median survival of 4.5 years after recurrence. In the European CUP trial, 89 patients with relapsed, nontransformed FL with partial response or CR after standard induction chemotherapy were randomized to 1 of 3 arms: 3 additional cycles of conventional chemotherapy (n=24), high-dose
chemotherapy and unpurged autologous HCT (n=33), or high-dose chemotherapy with purged autologous HCT (n=32). (21) OS at 4 years for the chemotherapy versus unpurged versus purged arms was 46%, 71%, and 77%, respectively. Two-year PFS was 26%, 58%, and 55%, respectively. No difference was found between the 2 autologous HCT arms. Although several studies have consistently shown improved disease-free survival (DFS) with autologous HCT for relapsed FL, this study was the first to show a difference in OS benefit.

**Section Summary**
Randomized trials have shown no survival advantage to HCT as first-line therapy for indolent B-cell lymphomas; however, randomized studies have shown a survival benefit for relapsed disease.

**Aggressive Lymphomas**

**HCT for First-Line Therapy for Aggressive NHL**
Several randomized trials reported on between 1997 and 2002 compared outcomes of autologous HCT used to consolidate a first CR in patients with intermediate or aggressive NHL, with outcomes of an alternative strategy that delayed transplants until relapse. As summarized in an editorial, the preponderance of evidence showed that consolidating first CRs with HCT did not improve OS for the full population of enrolled patients. However, a subgroup analysis at 8 years’ median follow-up focused on 236 patients at high or high-intermediate risk of relapse (based on age-adjusted IPI scores) who were enrolled in the largest of these trials (the LNH87-2 protocol; reference 19). The subgroup analysis reported superior OS (64% vs 49%, respectively; relative risk 1.51, p=0.04) and DFS (55% vs 39%, respectively; relative risk 1.56, p=0.02) for patients at elevated risk of relapse who were consolidated with an autologous HCT.

A large, multigroup, prospective, randomized Phase III comparison of these strategies (the S9704 trial) is ongoing to confirm results of the subgroup analysis in a larger population with DLBCL at high- and high-intermediate risk of relapse. Nevertheless, many clinicians view the LNH87-2 subgroup analysis (29) as sufficient evidence to support use of autologous HCT to consolidate a first CR when risk of relapse is high. In contrast, editorials and recent reviews agree that available evidence shows no survival benefit from autologous HCT to consolidate first CR in patients with intermediate or aggressive NHL at low- or low-intermediate risk of relapse (using age-adjusted IPI score).

Between 2005 and 2008, several reports of randomized trials have shown no survival benefit to HCT as first-line therapy for aggressive lymphomas, as summarized next:

Greb et al undertook a systematic review and meta-analysis to determine whether high-dose chemotherapy with autologous HCT as first-line treatment in patients with aggressive NHL improves survival compared with patients treated with conventional chemotherapy. (33) Fifteen RCTs including 3079 patients were eligible for the meta-analysis. Thirteen studies with 2018 patients showed significantly higher CR rates in the autologous HCT group (p=0.004). However, autologous HCT did not have an effect on OS when compared with conventional chemotherapy.
According to the IPI, subgroup analysis of prognostic groups showed no survival differences between autologous HCT and conventional chemotherapy in 12 trials, and EFS also was not significantly different between the two groups. Despite higher CR rates, the evidence suggests there is no benefit with autologous HCT as first-line treatment in aggressive NHL.

Betticher et al reported the results of a Phase III multicenter, randomized trial comparing sequential high-dose chemotherapy with autologous HCT to standard CHOP as first-line therapy in 129 patients with aggressive NHL. Remission rates were similar in the two groups, and after a median observation time of 48 months, there was no difference in OS with 46% in the sequential autologous HCT group and 53% in the group that received CHOP (p=0.48). Sequential autologous HCT did not confer any survival benefit as initial therapy in patients with aggressive NHL.

Baldissera et al reported on the results of a prospective RCT comparing high-dose chemotherapy and autologous HCT with conventional chemotherapy as frontline therapy in 56 patients with high-risk aggressive NHL. The 5-year actuarial OS and PFS were not statistically different between the two study groups; only DFS was statistically different (97% vs 47%, for the autologous HCT and conventional groups, respectively; p=0.02.)

Olivieri et al reported on a randomized study of 223 patients with aggressive NHL using upfront high-dose chemotherapy with autologous HCT versus conventional chemotherapy (plus autologous HCT in cases of failure). In the conventional group, 29 patients achieved a PR or no response and went on to receive high-dose chemotherapy and autologous HCT. With a median follow-up of 62 months, there was no difference in 7-year probability of survival (60% and 57.8%; p=0.5), DFS (62% and 71%; p=0.2), and PFS (44.9% and 40.9%; p=0.7, all respectively) between the two groups. Patients with aggressive NHL do not benefit from upfront autologous HCT.

Results of a Phase III multicenter randomized trial (SWOG-9704) of autologous HCT as consolidation for aggressive (high-intermediate or high-risk) diffuse B-cell NHL were published in October 2013. In this trial, 253 patients received 5 cycles of induction chemotherapy (CHOP, cyclophosphamide, doxorubicin, vincristine, prednisone with [n=156, 47%] or without rituximab). Those who had at least a partial response to 5 cycles of induction therapy were randomly assigned to receive 3 additional cycles of CHOP (n=128) or 1 additional cycle of CHOP followed by autologous HCT (n=125). The primary efficacy end points of the trial were 2-year PFS and OS. Two-year PFS rates were 69% and 55% in the HCT and control group, respectively (HR control vs HCT=1.72, 95% CI, 1.18 to 2.51, p=0.005). The 2-year OS rates in the HCT and control group were 74% and 71%, respectively (HR=1.26, 95% CI, 0.82 to 1.94, p=0.30). Unplanned exploratory analyses showed a differential treatment effect according to disease risk level. Among high-risk patients, the 2-year OS rate was 82% in the HCT group and 64% in the control group (log-rank test p=0.01). The main results of this trial comport with earlier study results in not discerning a significant effect of early autologous HCT on OS among a group of patients with high- intermediate- and high-risk diffuse B-cell NHL. However, it appears that the survival curve shows a plateau among the high-risk HCT patients out to perhaps 10 years after study registration. Although this evidence was from exploratory subset analysis, it further supports the medical necessity of this approach in such cases compared with nontransplant strategies.
**HCT for Relapsed, Aggressive NHL**

Autologous HCT is the treatment of choice for relapsed or refractory aggressive NHL for patients who achieve a CR or PR with second-line therapy. The pivotal trial establishing the superiority of autologous HCT for relapsed DLBCL was the PARMA trial, a prospective randomized study in which 215 patients with chemosensitive disease in first or second relapse of aggressive lymphoma were given 2 courses of conventional chemotherapy. (38) One hundred and nine patients responded and were randomized to receive 4 courses of chemotherapy plus radiation (n=54) or radiotherapy plus intensive chemotherapy and autologous HCT (n=55). The 2 groups did not differ in baseline characteristics. Median follow-up was 63 months. Response rate was 84% in the HCT group, versus 44% in the nontransplant group. EFS for the transplant group was 46% versus 12% in the nontransplant group (p=0.001), and OS was 53% in the transplant group versus 32% in the nontransplant group (p=0.038).

**Section Summary**

Data from randomized trials have shown conflicting results, but some have shown an overall survival benefit with HCT to consolidate a first CR in patients with aggressive B-cell lymphomas at high or high-intermediate risk of relapse.

Randomized studies of HCT for relapsed aggressive B-cell lymphomas have shown an overall survival benefit with this approach.

**Tandem Transplants**

No prospective controlled studies comparing tandem with single transplants have been identified in the published literature.

A pilot Phase II trial evaluated tandem high-dose therapy with stem-cell support between 1994 and 1999 in 45 patients with age adjusted-IPI equal to 3 untreated aggressive non-Hodgkin’s lymphoma. After induction, responders underwent tandem autologous transplantation; 31 out of 41 evaluable patients completed the program. There were 4 toxic deaths. The primary end point of the study was complete response rate, which was 49%. With a median follow-up of 114 months for surviving patients, the OS was 51%, and 19 of the 22 patients (86%) who reached a CR were alive and relapse-free. Prospective evaluation of quality of life and comorbidities of surviving patients did not reveal long-term toxicities.

A pilot study in 2005 included 41 patients with poor-risk NHL and Hodgkin’s disease who were given tandem high-dose chemotherapy and autologous HCT. Thirty-one patients (76%) completed both transplants. Overall toxic death rate was 12%. The study evaluated the maximum tolerated dose of the chemotherapeutic regimen and did not compare tandem versus single transplants for NHL.

Tarella et al reported on a multicenter, nonrandomized, prospective trial consisting of 112 patients with previously untreated DLBCL and age-adjusted IPI score of 2-3. All patients received rituximab-supplemented, early-intensified high-dose chemotherapy with multiple autologous HCT. Although
the treatment regimen appeared to improve patients’ life expectancy, the comparisons were made with historic controls that had received conventional chemotherapy.

A retrospective analysis of 34 high-risk NHL patients who underwent autologous HCT followed closely by reduced-intensity allogeneic HCT (“tandem auto-allo”) included patients treated from January 2002 to November 2010. In this study, researchers began to identify appropriate allogeneic donors at the initiation of the salvage regimen. The patients' median age was 47 years. Histologic subtypes were: diffuse large B-cell (n=5), follicular (n=14), transformed follicular (n=4), mantle-cell (n=5), plasmacytoid lymphoma (n=1), anaplastic large T-cell (n=2), and peripheral T-cell (n=3). HLA-identical sibling donors were located for 29 patients, and 10/10-matched unrelated individuals were identified for 5 cases. The median interval between autologous HCT and allogeneic HCT was 77 days (range 36–197 days). At a median follow-up of 46 months since allogeneic HCT, the 5-year OS was 77% and PFS was 68%. Six patients experienced disease relapse or progression, the 100-day TRM was 0%, and 2-year TRM incidence was 6%. These results suggest tandem autologous-allogeneic transplantation appears feasible in high-risk NHL patients having a HLA-identical donor, but further study is necessary to establish its role in this setting.

**Section Summary**

No randomized studies have been conducted on the use of tandem HCT for the treatment of non-Hodgkin lymphomas, and the published evidence comprises small numbers of patients. Therefore, the data on tandem transplants are insufficient to determine outcomes with this type of treatment.

**NHL Subtypes**

Several subtypes have emerged with unique clinical and biologic features that will be addressed separately in the policy (specifically MCL and PTCL).

**Mantle Cell Lymphoma**

In an attempt to improve the outcome of mantle-cell lymphoma (MCL), several Phase II trials investigated the efficacy of autologous HCT, with published results differing substantially. Some studies found no benefit to HCT, and others suggested an EFS advantage, at least in a subset of patients. (10) The differing results in these studies were likely due to different time points of transplant (first vs second remission) and other patient selection criteria.

In 2005, the results of the first randomized trial were reported by Dreyling et al of the European MCL Network. A total of 122 patients with MCL received either autologous HCT or interferon as consolidation therapy in first CR or PR. Among these patients, 43% had a low-risk, 11% had a high-intermediate risk, and 6% had a high-risk profile. Autologous HCT resulted in a PR rate of 17% and a CR rate of 81% (versus PR of 62% and CR of 37% with interferon). Survival curves for time to treatment failure (TTF) after randomization showed that autologous HCT was superior to interferon (p=0.003). There also was significant improvement in the 3-year PFS demonstrated in the autologous HCT versus interferon arm (54% and 25%, respectively; p=0.01). At the time of the reporting, no advantage was seen in OS, with a 3-year OS of 83% versus 77%. The results also suggested that the impact of autologous HCT could depend on the patient’s remission status prior
Hematopoietic Stem-Cell Transplantation for Non-Hodgkin Lymphomas

Till et al reported the results of the outcomes of 56 patients with MCL treated with induction chemotherapy with cyclophosphamide, vincristine, doxorubicin, and dexamethasone (hyperCVAD) with or without rituximab followed by autologous HCT in first CR or PR (n=21), CHOP with or without rituximab followed by autologous HCT in first CR or PR (n=15), or autologous HCT following disease progression (n=20). OS and PFS at 3 years among patients transplanted in CR or PR were 93% and 63% compared with 46% and 36%, all respectively, for patients transplanted with relapsed/refractory disease. The hazard of mortality among patients transplanted with relapsed or refractory disease was 6.1 times that of patients transplanted in first CR or PR (p=0.0001).

Geisler et al reported on 160 previously untreated patients with MCL with dose-intensified induction immunochemotherapy. Responders received high-dose chemotherapy with in vivo purged autologous HCT. Overall survival and CR was achieved in 96% and 54%, respectively. The 6-year OS, EFS, and PFS were 70%, 56%, and 66%, respectively, with no relapses occurring after 5 years.

Evens et al reported on 25 untreated patients with MCL who received induction chemotherapy, with an overall response rate of 74%. Seventeen patients received a consolidative autologous (n=13) or allogeneic (n=4) HCT. Five-year EFS and OS for all patients was 35% and 50%, respectively. After a median follow-up of 66 months, the 5-year EFS and OS for patients who received autologous HCT was 54% and 75%, respectively.

There have been several studies regarding RIC and allogeneic HCT. Khouri et al reported on results of RIC allogeneic HCT in 18 patients with relapsed MCL, and after a median follow-up of 26 months, the actuarial probability of EFS was 82% at 3 years. Maris et al evaluated allogeneic HCT in 33 patients with relapsed and recurrent MCL. At 2 years, the relapse and nonrelapse mortality rates were 9% and 24%, respectively, and the OS and DFS were 65% and 60%, respectively. (49)

Tam et al reported a retrospective study which included all patients with MCL who had undergone HCT in sequential Phase 2 protocols (autologous or nonmyeloablative allogeneic) at the University of Texas M.D. Anderson Cancer Center between February 1990 and June 2007. (50) The approach to transplantation was risk-adapted and based primarily on the patient’s treatment status. Autologous HCT was performed as consolidation therapy for patients in first remission after chemotherapy (1990-2001). From 2001 onward, because of the favorable clinical outcomes found with rituximab (R)-hyperCVAD chemotherapy, autologous HCT was performed only in patients not in CR after R-hyperCVAD and in patients who had received less-intensive induction chemotherapy (e.g., CHOP-R). For patients with relapsed or primary refractory MCL, autologous HCT was performed before the use of nonmyeloablative allogeneic in 1997. After 1997, nonmyeloablative allogeneic was performed whenever a histocompatible donor was available. Patients generally underwent autologous HCT up to the age of 70 and RIC-allogeneic up to the age of 65 years. Since 2004, patients up to the age of 75 years could receive an autologous transplant. The study included 121 patients with MCL: 50 who underwent autologous HCT in first CR (46%) or PR (54%) (AUTO1),
36 who underwent autologous HCT for relapsed or refractory disease (AUTO2), and 35 who underwent nonmyeloablative allogeneic for relapsed or refractory disease (NST). The ages at transplantation were similar in all 3 groups (median, 57 years [range: 38–73 years] for AUTO1; median, 59 years [range: 42–76 years] for AUTO2; and median, 58 years [range: 43–68 years] for NST).

For the AUTO1 group, at a median follow-up of 6 years, the actuarial PFS and OS were 39% and 61%, respectively, with median PFS and OS durations of 42 months and 93 months. Of the AUTO2 patients, 31% did not experience a response to initial chemotherapy but did experience a PR or better to salvage therapy with hyperCVAD (n=6), R-hyperCVAD (n=4), or methotrexate and ara-C (n=1). Seventeen patients (47%) were in their second remission, 3 (8%) were in their third or subsequent remission, and 5 (14%) had chemorefractory relapse and were transplanted in less than partial remission. The actuarial 6-year PFS and OS rates were 10% and 35%, respectively (p=0.01 and 0.02 compared with AUTO1), and the median PFS and OS durations were 27 and 52 months, respectively. These inferior results for both PFS and OS compared with AUTO1 patients were maintained in a multivariate analysis that accounted for differences in baseline factors.

Of the patients who underwent nonmyeloablative allogeneic HCT for relapsed or refractory MCL, 20% did not experience a response to initial chemotherapy but experienced a PR or better to salvage therapy with R-hyperCVAD. Thirty-one percent were in their second remission, 31% were in their third or subsequent remission, and 17% had refractory relapse and received a transplant in less than partial remission. With a median follow-up of 56 months (range, 19-110 months), the median PFS duration was 60 months, and the median OS had not yet been reached. The 6-year actuarial PFS rate was 46%, and the 6-year actuarial OS rate was 53%. Plateaus in the survival curves were observed for both PFS and OS, with no relapses or deaths occurring in 9 patients followed between 63 and 110 months. These outcomes were significantly superior to that of AUTO2 patients, whereby relapses and deaths occurred in a continuous fashion (p=0.01 for PFS; p=0.005 for OS [4-year landmark for OS]). Compared with AUTO1 patients, the RIC-allogeneic HCT patients had an initially lower OS; however, this reversed at 8 years because of the lack of late deaths among nonmyeloablative allogeneic patients.

This study provides evidence that MCL may be curable in both the frontline and salvage settings. In chemotherapy-naïve patients, the results showed that rituximab-containing autologous HCT in first remission may result in long-term disease control, with only 1 relapse occurring among 11 patients followed between 2 and 8 years, in contrast to that of autologous transplantation without rituximab, in which relapses occurred in a continuous fashion. In contrast to frontline transplantation, the outcomes of autologous transplantation in patients with relapsed or refractory MCL remain unsatisfactory, with no evidence of a cured fraction on survival curves. The results of autologous and nonmyeloablative allogeneic HCT in patients with relapsed or refractory MCL were also markedly different. Patients receiving a nonmyeloablative allogeneic transplant showed significantly superior disease control and a disease-free plateau, extending between 5 and 9 years, whereas patients who received an autologous transplant had a median remission of 2 years and experienced a continuous pattern of relapse. Therefore, nonmyeloablative allogeneic HCT may be capable of salvaging a cure in patients no longer curable with maximum cytotoxic strategies.
Two recent major therapeutic advances have substantially altered the outlook of patients with MCL: 1) the introduction of rituximab, which in combination with chemotherapy, has improved the results of both frontline and salvage treatments for MCL, and 2) the combination of rituximab and hyperCVAD, which is capable of achieving CR rates of up to 90% in the frontline setting, with a prolonged 5-year failure-free survival of 60% in younger patients.

As noted in the Tam et al study, recent review articles on high-dose therapy for MCL reiterate the finding in several studies of a superior result of transplantation in first CR (autologous or allogeneic) rather than in the relapsed setting, and that intensive immunochemotherapy as induction therapy preceding high-dose therapy plus autologous HCT is indicated. Also noted are the results of the use of reduced-intensity allogeneic HCT in the relapsed setting, showing survival plateaus and suggesting curative potential and suggesting benefit in the use of this approach in younger, fit patients with relapsed MCL.

**Section Summary**

Due in part to the relative rarity of the disease, randomized studies on the use of HCT in MCL have not been conducted. Case series have shown long-term disease control of this aggressive lymphoma with the use of autologous HCT (with rituximab) to consolidate a first remission; however, the use of autologous HCT in the relapsed setting has not shown improved outcomes. Allogeneic HCT has shown prolonged disease control in the relapsed/refractory setting.

**Peripheral T-Cell Lymphoma (Mature T-cell or NK-cell neoplasms)**

**First-line autologous HCT (Newly Diagnosed)**

Only a few prospective studies with small numbers of patients have investigated autologous HCT in patients with aggressive PTCL.

Reimer et al conducted the largest prospective study of 83 patients with PTCL from multiple centers to undergo autologous HCT as first-line therapy. Patients had various histologies, including PTCL-NOS (not otherwise specified) (n=32), angioimmunoblastic (n=27), anaplastic lymphoma kinase-anaplastic large-cell lymphomas (ALK–ALCL) (n=13), and the remainder extranodal subtypes. Sixty-six percent of the patients received the transplant, with the main reason for not receiving the transplant being progression of disease. Of the patients who proceeded to transplant, 32 were in CR and 33 in PR. Treatment-related mortality (TRM) was 3.6%. Median follow-up was 33 months, and the estimated 3-year OS and PFS rates were 48% and 36%, respectively.

Corradini et al. reported the results of two Phase II studies involving 62 patients with advanced stage PTCL at diagnosis. In an ITT analysis, 46 of the 62 (74%) completed the whole program. The 16 patients failed to undergo transplant due to early disease progression and/or toxicity. Pretransplant, 56% of patients were in CR, and 16% in PR. Median follow-up was 76 months, with an estimated 12-year OS, DFS, and EFS of 34%, 55%, and 30%, respectively. Five-year EFS and OS were 40 and 50%, respectively. A multivariate analysis showed that patients who achieved CR before HCT had a statistically significant benefit in OS and EFS (p<0.001).
Mercadal et al reported results of a Phase II trial involving 41 patients consecutively diagnosed with PTCL (median age: 47 years). Patients who responded to induction chemotherapy (CR or PR) went on to autologous HCT. Twenty-four patients responded (CR n=20 and PR n=4). Seventeen of these 24 underwent HCT (the remaining patients did not due to various reasons including lack of stem-cell mobilization, toxicity, and early relapse). For patients who completed the entire procedure, CR was 51% and PR, 7%. Median follow-up was 3.2 years (range: 0.6–8.1), and 5 of 21 CR patients relapsed and 2 died in CR due to a secondary malignancy. Four-year PFS was 30% (95% CI, 15%–45%), and OS was 39% (95% CI, 22%–56%). No difference in OS was noted among the 24 patients who were eligible for transplant, 17 of whom underwent transplant and 7 who did not.

A prospective Phase II trial by Rodriguez et al showed that autologous HCT as first-line consolidation therapy improved treatment outcome in patients responding to induction therapy. Nineteen of 26 patients who showed CR or PR to induction therapy received an autologous HCT. At 2 years’ post-transplant, OS, PFS, and DFS were 84%, 56%, and 63%, respectively.

**Salvage (relapsed or refractory) autologous HCT**

Kewalramani et al retrospectively compared a review of 24 consecutive patients with PTCL who underwent autologous HCT for relapsed or refractory disease after responding to second-line therapy and compared the results with those of 86 consecutive patients with chemosensitive relapsed or primary refractory DLBCL. (56) Patients with less aggressive histologies (eg, ALCL expressing the ALK protein) were excluded. Median follow-up time was 6 years, and the 5-year PFS rates for PTCL and DLBCL were 24% and 34%, respectively (p=0.14). OS rates were 33% and 39%, respectively. Disease progression occurred in 83% of patients with PTCL and 65% of patients with DLBCL (p=0.13). In a univariate analysis of survival for patients with PTCL, response to second-line therapy and the second-line age-adjusted international prognostic index (sAAIPI) were prognostic for both PFS and OS. The outcomes for PTCL and DLBCL patients were similar when stratified by the sAAIPI, in contrast to patients undergoing first-line chemotherapy, where T-cell histology consistently confers a poorer prognosis across IPI subgroups.

Song et al compared the outcomes of 36 patients with PTCL who underwent autologous HCT with 97 patients with relapsed DLBCL. Of the patients with PTCL, 27 were at first relapse, 2 at greater than 1 relapse and 7 had primary refractory disease. Twenty patients had PTCL-u, 9 had ALCL, and the remainder a mixture of rarer subtypes. Baseline patient characteristics were similar between the PTCL and DLBCL groups. Three-year OS and EFS were 48% and 37%, respectively for PTCL and 53% and 42% for DLBCL (p=0.41 and 0.29, respectively). The patients with PTCL-u had an inferior EFS when compared with the DLBCL patients (23%, p=0.028), and those with ALCL had a nonsignificant trend for improved EFS (67%, p=0.41).

Rodriguez et al reported the largest series of patients with refractory or relapsed PTCL who received an autologous HCT. One-hundred twenty-three patients were derived from registry data between 1990 and 2004. Response to transplantation was as follows: in patients in whom response could be assessed (119 of 123), 73% achieved a CR, 11% a PR, and transplant failed to produce benefit in 16% of patients who had stable or progressive disease. Median follow-up was 61 months
(range: 0–182). Five-year PFS was 34% (95% CI, 25%–44%) and 5-year OS was 45% (95% CI, 36%–55%). DFS at 5 years for complete responders was 47% (95% CI, 35%–58%).

**Allogeneic HCT**

A recent review article on the impact of HCT in peripheral T-cell lymphomas states that no relevant data for the use of allogeneic HCT in the front-line setting are available. To further investigate the role of HCT in previously untreated PTCL, the DSHNHL (German High-grade NHL Study Group) will initiate a prospective randomized multicenter trial comparing upfront autologous versus allogeneic HCT following induction chemotherapy.

For relapsing and refractory PTCL, data on the use of allogeneic HCT consist of case reports and approximately 5 retrospective series with at least 10 patients.

Jacobsen et al reported a single-center experience over 12 years using allogeneic HCT in 52 patients with PTCL or advanced mycosis fungoides/Sezary syndrome. (60) Patients had a variety of disease subtypes, including nodal and extranodal histologies. Eleven patients had undergone a prior autologous HCT. At the time of the allogeneic HCT, 23 patients (44%) were in first or subsequent CR and 16 (31%) had a PR. Thirty-one (60%) patients underwent myeloablative conditioning and 21 (40%) underwent RIC. The median follow-up was 49 months. Three-year PFS was 30% (45% in patients with nodal histologies and 6% in patients with extranodal histologies). Overall survival at 3 years was 41% for all patients. The evidence suggests allogeneic HCT can produce long-term remissions in relapsed/refractory T-cell lymphoma; plateaus in both OS and PFS curves suggest that allogeneic HCT may be curative in a select group of patients.

Kyriakou et al reported the outcomes of 45 patients with angioimmunoblastic lymphoma who were in the European Group for Blood and Marrow Transplantation database and had undergone an allogeneic HCT between 1998 and 2005. Angioimmunoblastic lymphoma is characterized by an aggressive clinical course and carries a poor prognosis; with chemotherapy, OS is less than 30% at 5 years. Eleven patients had failed a prior autologous transplant. Twenty-five patients underwent myeloablative and 20 (RIC. Non-relapse mortality was 18%, 22%, and 25% at 3, 6, and 12 months, respectively. The median follow-up time for the surviving patients was 29 months (range 6-76 months). The estimated OS rate at 1 and 3 years was 66% and 64%, respectively. OS for chemotherapy-sensitive patients was significantly better at 81% at 3 years.

Corradini et al reported outcomes of 17 patients with relapsed or refractory PTCL who underwent a reduced intensity allogeneic HCT. Median age of the patients was 41 years (range: 23-60 years). Two of the patients had primary chemorefractory disease, 15 had relapsed disease, and 8 had disease relapse after a prior autologous HCT. After a median follow-up of 28 months from the day of study entry (range: 3-57 months), 14 patients were alive. PFS and OS at 3 years were 64% (95% CI, 39%–89%) and 81% (95% CI, 62%–100%), respectively. In this initial series, 15 of the 17 patients had chemotherapy-sensitive disease before transplant. In an update of their experience in 35 patients with a median follow-up of 44 months, PFS and OS were 49% and 54%, respectively.
Le Gouill et al retrospectively reported a large series of patients with several different aggressive histologic subtypes of peripheral T-cell lymphoma who underwent allogeneic HCT. Seventy-seven patients from 20 French centers who underwent transplant between 1988 and 2006 were included. Median age at diagnosis was 36 years (range: 12–61 years). Median follow-up was 43 months (range, 3.5 to 195 months). Fifty-seven patients received a myeloablative conditioning regimen. All of the patients had received at least one line of therapy before the allogeneic HCT, including an autologous HCT in 25% of cases. Five-year toxicity-related mortality incidence was 33% (95% CI, 24%–46%). Overall 5-year OS and EFS rates were 57% (95% CI, 45%–68%) and 53% (95% CI, 4%–64%), respectively. There was a large variation in OS and EFS rates by the histopathologic subtypes: 5-year OS and EFS rates were 80% (95% CI, 39%–94%) and 80% (95% CI, 39%–94%) for patients with angioimmunoblastic T-cell lymphoma, 63% (95% CI, 41% to 79%) and 58% (95% CI, 35%–75%) for PTCL-NOS, and 55% (95% CI, 35%–72%), and 48% (95% CI, 28%–65%) for ALCL patients, respectively. The 5-year OS for other histopathologic subtypes (n=12) was 33% (95% CI, 8%–58%), and 4 of these patients were still alive in CR. All of the patients who could not achieve CR after allogeneic HCT died within 10 months as a result of disease progression. In a multivariate analysis, the strongest predictors of OS were chemotherapy-resistant disease at the time of the allogeneic transplant and the occurrence of severe (grade 3 or 4) acute GVHD.

Section Summary

The role of HCT in peripheral T-cell lymphoma (PTCL) is not well-defined. Few studies have been conducted, many of these retrospectively, with small numbers of patients and heterogeneous patient populations including good- and poor-risk patients in the same study. This is partly due to the rarity and heterogeneity of this group of lymphomas. In particular, studies often mix patients with PTCL-NOS (NOS, not otherwise specified, which has a poorer prognosis) with patients with anaplastic lymphoma kinase-anaplastic large-cell lymphomas (ALK + ALCL), which has a better prognosis (even with conventional chemotherapy regimens), and ALK- ALCL patients who have a worse prognosis than ALK+ ALCL but better than PTCL-NOS patients. There have been no randomized studies comparing chemotherapy regimens solely in patients with peripheral T-cell lymphoma (i.e., some randomized studies have included peripheral T-cell lymphoma with aggressive B-cell lymphomas). For frontline therapy, results from recent phase II studies with autologous HCT as consolidation offers the best survival outcomes for patients with high-risk features; randomized trials to confirm this have not been performed. No relevant data for the use of allogeneic HCT in the front-line setting are available. Patients with relapsed or refractory PTCL are generally considered incurable with chemotherapy alone. In the salvage setting, the data show that the use of HCT may improve survival outcomes similar to the results seen in corresponding aggressive B-cell lymphomas in the same treatment setting.

Reviews summarize the most recent and largest studies on the use of HCT as first-line (newly diagnosed) and salvage therapy for PTCL. For frontline therapy, results from recent phase II studies with autologous HCT as consolidation offers the best survival outcomes for patients with high-risk features; randomized trials to confirm this have not been performed. No relevant data for the use of allogeneic HCT in the front-line setting are available.
Approximately 30%–60% of these patients do not reach transplantation due to early disease progression or toxicity, and 20%–30% relapse after transplantation. Patients with relapsed or refractory disease are generally considered incurable with chemotherapy alone. In the salvage setting, the data show that the use of HCT may improve survival outcomes similar to the results seen in corresponding aggressive B-cell lymphomas in the same treatment setting.

**Ongoing and Unpublished Clinical Trials**

A search of the National Cancer Institute’s Physician Data Query database identified 16 phase 3 trials that directly address the use of HCT for different types of NHL (http://www.cancer.gov/clinicaltrials/search/results?protocolsearchid=12281861).

**Clinical input Received through Physician Specialty Society and Academic Medical Centers**

While the various physician specialty societies and academic medical centers may collaborate with and make recommendations during this process through the provision of appropriate reviewers, input received does not represent an endorsement or position statement by the physician specialty societies or academic medical centers, unless otherwise noted.

**2009 Input**

In response to requests, input was received from 1 physician specialty society and 1 academic medical center while this policy was under review for March 2009. There was general agreement with the policy statements. Both reviewers agreed that RIC allogeneic HCT should be considered medically necessary in patients with NHL who do not qualify for a myeloablative allogeneic HCT. One reviewer responded on the medical necessity of HCT in patients with MCL in first remission and recently published literature supports this. There was conflicting input on whether HCT should be considered investigational for peripheral T-cell lymphoma. Also, one reviewer commented that with the increasing use of rituximab and its success in improving patient outcomes, the role of HCT in consolidating first CR in high-risk patients is coming into question.

**2011 Input**

In response to requests, input was received from 3 physician specialty societies and 3 academic medical centers while this policy was under review for February 2011. Reviewer input was solicited particularly for the use of HCT in MCL and PTCL. There was uniform agreement for the use of autologous HCT to consolidate a first remission in MCL. There was general agreement for the use of allogeneic HCT as salvage therapy for MCL, with less agreement on the use of autologous HCT in the salvage setting. For PTCL, there was general agreement on the use of autologous HCT to consolidate a CR in high-risk patients and in the salvage setting. Input was split on the use of allogeneic HCT to consolidate a first CR or as salvage therapy, but there was more support to consider it medically necessary in both settings.

**Summary of Evidence**

Randomized trials have shown no survival advantage to HCT as first-line therapy for indolent B-cell lymphomas; however, randomized studies have shown a survival benefit for relapsed disease.
Data from randomized trials have shown conflicting results, but some have shown an overall survival benefit with HCT to consolidate a first complete remission (CR) in patients with aggressive B-cell lymphomas at high or high-intermediate risk of relapse. Randomized studies of HCT for relapsed aggressive B-cell lymphomas have shown an overall survival benefit with this approach.

No randomized studies have been conducted on the use of tandem HCT for the treatment of non-Hodgkin lymphoma, and the published evidence comprises small numbers of patients. Therefore the data on tandem transplants are insufficient to determine outcomes with this type of treatment.

Due in part to the relative rarity of the disease, randomized studies on the use of HCT in mantle cell lymphoma have not been conducted. Case series have shown long-term disease control of this aggressive lymphoma with the use of autologous HCT (with rituximab) to consolidate a first remission; however, the use of autologous HCT in the relapsed setting has not shown improved outcomes. Allogeneic HCT has shown prolonged disease control in the relapsed/refractory setting.

The role of HCT in peripheral T-cell lymphoma (PTCL) is not well-defined. Few studies have been conducted, many of these retrospectively, with small numbers of patients and heterogeneous patient populations including good- and poor-risk patients in the same study. This is partly due to the rarity and heterogeneity of this group of lymphomas. In particular, studies often mix patients with PTCL-NOS (NOS [not otherwise specified], which has a poorer prognosis) with patients with anaplastic lymphoma kinase anaplastic large-cell lymphomas (ALK + ALCL), which has a better prognosis (even with conventional chemotherapy regimens), and ALK - ALCL patients who have a worse prognosis than ALK + ALCL but better than PTCL-NOS patients. There have been no randomized studies comparing chemotherapy regimens solely in patients with PTCL (ie, some randomized studies have included PTCL with aggressive B-cell lymphomas). For frontline therapy results from recent phase II studies with autologous HCT as consolidation offers the best survival outcomes for patients with high-risk features; randomized trials to confirm this have not been performed. No relevant data for the use of allogeneic HCT in the front-line setting are available. Patients with relapsed or refractory PTCL are generally considered incurable with chemotherapy alone. In the salvage setting, the data show that the use of HCT may improve survival outcomes similar to the results seen in corresponding aggressive B-cell lymphomas in the same treatment setting.

**Practice Guidelines and Position Statements**

**National Cancer Institute PDQ Database**
A search of the National Cancer Institute’s Physician Data Query database identified 9 phase III trials that directly address the use of HCT for different types of non-Hodgkin lymphoma (available online at: [http://www.cancer.gov/clinicaltrials/search/results?protocolsearchid=12281861](http://www.cancer.gov/clinicaltrials/search/results?protocolsearchid=12281861)).

**National Comprehensive Cancer Network (NCCN) guidelines**
The updated NCCN Guidelines (v1.2014) for NHL are unchanged from the prior version.
Follicular lymphoma/Indolent lymphomas
- Autologous HCT as consolidative therapy for patients in second or third remission (category 2A)
- Allogeneic (fully myeloablative or nonmyeloablative) in highly selected patients

Diffuse large B-cell lymphoma
- Autologous HCT as first-line consolidation in high-risk patients. (category 2B)
- Autologous HCT for relapsed or refractory disease. (category 2A)

Mantle cell lymphoma
- Autologous HCT as consolidative therapy in first remission. (category 2A)
- Autologous HCT for patients with relapsed disease following CR to induction therapy, those patients who obtain only a PR to induction therapy, or those with progressive disease. (category 2A)
- Allogeneic (fully myeloablative or nonmyeloablative) for second-line consolidation. (category 2A)

Peripheral T-cell lymphoma
- Autologous HCT as first-line consolidation therapy in patients showing a good response to induction therapy (except those considered low-risk, e.g., ALCL ALK-positive). (category 2A)
- Autologous or allogeneic (fully myeloablative or nonmyeloablative) HCT as second-line consolidation in patients with relapsed or refractory disease with PR or CR to second-line therapy. (category 2A)

Cutaneous T-cell lymphoma (Mycosis Fungoides/Sezary Syndrome)
- For relapsed, refractory, or progressive disease, consider allogeneic HCT. (category 2A)

Adult T-cell leukemia/lymphoma
- After CR or for persistent or progressive disease, consider allogeneic HCT. (category 2A)

VIII. Important Reminder

The purpose of this Medical Policy is to provide a guide to coverage. This Medical Policy is not intended to dictate to providers how to practice medicine. Nothing in this Medical Policy is intended to discourage or prohibit providing other medical advice or treatment deemed appropriate by the treating physician.

Benefit determinations are subject to applicable member contract language. To the extent there are any conflicts between these guidelines and the contract language, the contract language will control.

This Medical Policy has been developed through consideration of the medical necessity criteria under Hawaii’s Patients’ Bill of Rights and Responsibilities Act (Hawaii Revised Statutes §432E-1.4), generally accepted standards of medical practice and review of medical literature and government
approval status. HMSA has determined that services not covered under this Medical Policy will not be medically necessary under Hawaii law in most cases. If a treating physician disagrees with HMSA’s determination as to medical necessity in a given case, the physician may request that HMSA reconsider the application of the medical necessity criteria to the case at issue in light of any supporting documentation.

IX. References

42. Dreyling M, Lenz G, Hoster E, et al. Early consolidation by myeloablative radiochemotherapy followed by autologous stem cell transplantation in first remission significantly prolongs