Hematopoietic Cell Transplantation in the Treatment of Germ Cell Tumors (GCT)

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Policy
Blue Cross and Blue Shield of Kansas City (Blue KC) will provide coverage for hematopoietic cell transplantation in the treatment of germ cell tumors when it is determined to be medically necessary because the criteria shown below are met.

When Policy Topic is covered
Single autologous hematopoietic cell transplantation may be considered medically necessary as salvage therapy for germ-cell tumors:

- in patients with favorable prognostic factors that have failed a previous course of conventional-dose salvage chemotherapy; or
- in patients with unfavorable prognostic factors as initial treatment of first relapse (i.e., without a course of conventional-dose salvage chemotherapy) and in patients with platinum-refractory disease. (See Considerations section for prognostic factors.)

Tandem autologous HCT or transplant with sequential high-dose chemotherapy may be considered medically necessary for the treatment of testicular tumors either as salvage therapy or with platinum-refractory disease.

When Policy Topic is not covered
Autologous hematopoietic cell transplantation is considered investigational as a component of first-line treatment for germ-cell tumors.

Allogeneic hematopoietic stem-cell transplantation is considered investigational to treat germ-cell tumors, including, but not limited to its use as therapy after a prior failed autologous hematopoietic cell transplantation.

Considerations
The favorable and unfavorable prognostic factors listed below are derived from the current National Comprehensive Cancer Network (NCCN) guidelines (1) and the
Devita, Hellman, and Rosenberg’s textbook *Cancer Principles and Practice of Oncology*. (2)

Patients with favorable prognostic factors include those with a testis or retroperitoneal primary site, a complete response to initial chemotherapy, low levels of serum markers and low volume disease. Patients with unfavorable prognostic factors are those with an extratesticular primary site, an incomplete response to initial therapy, high levels of serum markers, high-volume disease, or relapsing mediastinal nonseminomatous germ-cell tumors.

**Description of Procedure or Service**

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Therapy for germ cell tumors is generally dictated by several factors, including disease stage, tumor histology, site of tumor primary, and response to chemotherapy. Patients with unfavorable prognostic factors may be candidates for hematopoietic cell transplantation (HCT).

For individuals who have previously untreated germ cell tumors who receive autologous HCT as first-line therapy, the evidence includes randomized controlled trials (RCTs). Relevant outcomes are overall survival, disease-specific survival, and treatment-related mortality and morbidity. Results from the RCTs have shown that
autologous HCT as initial therapy for germ cell tumors did not significantly improve outcomes compared with alternative therapy (eg, standard-dose chemotherapy). Study sample sizes were relatively small and might have been underpowered to detect differences between groups. The evidence is insufficient to determine the effects of the technology on health outcomes.

For individuals who have relapsed or refractory germ cell tumors who receive autologous HCT, the evidence includes an RCT and several case series. Relevant outcomes are overall survival, disease-specific survival, and treatment-related mortality and morbidity. The RCT did not find significant differences in outcomes between autologous HCT plus high-dose chemotherapy and standard-dose chemotherapy. Case series found three-year overall survival rates that ranged from 55% to 60%; these studies lacked comparison groups. The evidence is insufficient to determine the effects of the technology on health outcomes.

For individuals who have germ cell tumors who receive tandem autologous transplantation and sequential HDC, the evidence includes an RCT, several retrospective cohort studies, and a comparative effectiveness review. The relevant outcomes are OS, DSS, and TRM and morbidity. The RCT reported a higher rate of TRM with sequential HDC compared with single HDC. However, five-year survival outcomes did not differ significantly between groups. Overall, the available studies have included heterogeneous patient populations, in different salvage treatment settings (ie, first vs subsequent salvage therapy), and have lacked a universally accepted prognostic scoring system to risk-stratify patients. Tandem autologous transplant or transplant with sequential HDC has not shown a benefit in patients with primary mediastinal germ cell tumors. The evidence is insufficient to determine the effects of the technology on health outcomes.

For individuals who have germ cell tumors who receive allogeneic HCT, the evidence includes a case report. The relevant outcomes are OS, DSS, and TRM and morbidity. There were no RCTs or nonrandomized comparative studies evaluating allogeneic HCT for germ cell tumors. One 2007 case report has described successful treatment of a refractory mediastinal germ cell tumor with allogeneic HCT. The evidence is insufficient to determine the effects of the technology on health outcomes.

Clinical input obtained in 2010 found strong support for autologous HCT as a treatment of relapsed or refractory germ cell tumors, and for tandem autologous transplant or transplant with sequential high-dose chemotherapy as salvage therapy for testicular tumors and as treatment of platinum-refractory testicular tumors. Input was generally consistent with recommendations in national and international guidelines. Thus, these indications may be considered medically necessary.

**Background**

**Germ Cell Tumors**

Germ cell tumors are composed primarily of testicular neoplasms as well as ovarian and extragonadal germ cell tumors (no primary tumor in either testis or
ovary). Germ cell tumors are classified by their histology, stage, prognosis, and response to chemotherapy.

The most common testicular germ cell tumors are seminomas; all other histologic types are collectively referred to as nonseminomatous tumors. Nonseminomatous tumor types include embryonal cell tumor, yolk sac tumor, and teratomas. Malignant germ cell tumors of ovarian origin are classified as dysgerminomas or nondysgerminomas. Similarly, nondysgerminomas include immature teratomas, embryonal cell tumors, yolk sac tumor, polyembryoma, and mixed germ cell tumors.

**Staging**
Stage depends on location and extent of the tumor, using the American Joint Committee on Cancer's TNM system. TNM stages, modified by serum concentrations of markers for tumor burden (S0-3) when available, are grouped by similar prognoses. Markers used for germ cell tumors include human β-chorionic gonadotropin, lactate dehydrogenase, and α-fetoprotein. However, most patients with pure seminoma have normal α-fetoprotein concentrations. For testicular tumors, stages IA to B tumors are limited to the testis (no involved nodes or distant metastases) and no marker elevations (S0); stages IIA to C have increasing size and number of tumor-involved lymph nodes, and at least one marker moderately elevated above the normal range (S1), and stages IIIA to C have distant metastases and/or marker elevations greater than specified thresholds (S2-3).

Germ cell tumors also are divided into good-, intermediate-, or poor-risk categories based on histology, site, extent of the primary tumor, and serum marker levels. Good-risk pure seminomas can be at any primary site but are without nonpulmonary visceral metastases or marker elevations. Intermediate-risk pure seminomas have nonpulmonary visceral metastases with or without elevated human chorionic gonadotropin and/or lactate dehydrogenase. There are no poor-risk pure seminomas, but mixed histology tumors and seminomas with elevated α-fetoprotein (due to the mixture with nonseminomatous components) are managed as nonseminomatous germ cell tumors. Good- and intermediate-risk nonseminomatous germ cell tumors have testicular or retroperitoneal tumors without nonpulmonary visceral metastases, and either S1 (good-risk) or S2 (intermediate) levels of marker elevations. Poor-risk tumors have mediastinal primary tumors, or nonpulmonary visceral metastases, or the highest level (S3) of marker elevations.

**Hematopoietic Cell Transplantation**
HCT is a procedure in which hematopoietic stem cells are intravenously infused to restore bone marrow and immune function in cancer patients who receive bone marrow-toxic doses of cytotoxic drugs with or without whole-body radiotherapy. Hematopoietic stem cells may be obtained from the transplant recipient (autologous HCT) or a donor (allogeneic HCT [allo-HCT]). They can be harvested from bone marrow, peripheral blood, or umbilical cord blood shortly after delivery of neonates. Cord blood transplantation is discussed in detail in separate policy.
Immunologic compatibility between infused hematopoietic stem cells and the recipient is not an issue in autologous HCT. In allogeneic stem cell transplantation, immunologic compatibility between donor and patient is a critical factor for achieving a successful outcome. Compatibility is established by typing of human leukocyte antigens (HLA) using cellular, serologic, or molecular techniques. HLA refers to the gene complex expressed at the HLA-A, -B, and -DR (antigen-D related) loci on each arm of chromosome 6. An acceptable donor will match the patient at all or most of the HLA loci.

Conditioning for Hematopoietic Cell Transplantation

Conventional Conditioning
The conventional (“classical”) practice of allo-HCT involves administration of cytotoxic agents (e.g., cyclophosphamide, busulfan) with or without total body irradiation at doses sufficient to cause bone marrow ablation in the recipient. The beneficial treatment effect of this procedure is due to a combination of the initial eradication of malignant cells and subsequent graft-versus-malignancy effect mediated by non-self-immunologic effector cells. While the slower graft-versus-malignancy effect is considered the potentially curative component, it may be overwhelmed by existing disease in the absence of pretransplant conditioning. Intense conditioning regimens are limited to patients who are sufficiently medically fit to tolerate substantial adverse effects. These include opportunistic infections secondary to loss of endogenous bone marrow function and organ damage or failure caused by cytotoxic drugs. Subsequent to graft infusion in allo-HCT, immunosuppressant drugs are required to minimize graft rejection and graft-versus-host disease, which increases susceptibility to opportunistic infections.

The success of autologous HCT is predicated on the potential of cytotoxic chemotherapy, with or without radiotherapy, to eradicate cancerous cells from the blood and bone marrow. This permits subsequent engraftment and repopulation of the bone marrow with presumably normal hematopoietic stem cells obtained from the patient before undergoing bone marrow ablation. Therefore, autologous HCT is typically performed as consolidation therapy when the patient’s disease is in complete remission. Patients who undergo autologous HCT are also susceptible to chemotherapy-related toxicities and opportunistic infections before engraftment, but not graft-versus-host disease.

Reduced-Intensity Conditioning Allogeneic Hematopoietic Cell Transplantation
RIC refers to the pretransplant use of lower doses of cytotoxic drugs or less intense regimens of radiotherapy than are used in traditional full-dose myeloablative conditioning treatments. Although the definition of RIC is variable, with numerous versions employed, all regimens seek to balance the competing effects of relapse due to residual disease and non-relapse mortality. The goal of RIC is to reduce disease burden and to minimize associated treatment-related morbidity and non-relapse mortality in the period during which the beneficial graft-versus-malignancy effect of allogeneic transplantation develops. RIC regimens
range from nearly total myeloablative to minimally myeloablative with lymphoablation, with intensity tailored to specific diseases and patient condition. Patients who undergo RIC with allo-HCT initially demonstrate donor cell engraftment and bone marrow mixed chimerism. Most will subsequently convert to full-donor chimerism. In this review, the term reduced-intensity conditioning will refer to all conditioning regimens intended to be nonmyeloablative.

**Regulatory Status**
The FDA regulates human cells and tissues intended for implantation, transplantation, or infusion through the Center for Biologics Evaluation and Research, under Code of Federal Regulation, Title 21, parts 1270 and 1271. Hematopoietic stem cells are included in these regulations.

**Rationale**
This evidence review was created in April 2000 and has been updated regularly with searches of the MEDLINE database. The most recent literature update was performed through November 11, 2019.

Evidence reviews assess the clinical evidence to determine whether the use of technology improves the net health outcome. Broadly defined, health outcomes are the length of life, quality of life, and ability to function—including benefits and harms. Every clinical condition has specific outcomes that are important to patients and manage the course of that condition. Validated outcome measures are necessary to ascertain whether a condition improves or worsens; and whether the magnitude of that change is clinically significant. The net health outcome is a balance of benefits and harms.

To assess whether the evidence is sufficient to draw conclusions about the net health outcome of technology, 2 domains are examined: the relevance, and quality and credibility. To be relevant, studies must represent one or more intended clinical use of the technology in the intended population and compare an effective and appropriate alternative at a comparable intensity. For some conditions, the alternative will be supportive care or surveillance. The quality and credibility of the evidence depend on study design and conduct, minimizing bias and confounding that can generate incorrect findings. The RCT is preferred to assess efficacy; however, in some circumstances, nonrandomized studies may be adequate. RCTs are rarely large enough or long enough to capture less common adverse events and long-term effects. Other types of studies can be used for these purposes and to assess generalizability to broader clinical populations and settings of clinical practice.

**Autologous Hematopoietic Cell Transplantation as First-Line Therapy for Germ Cell Tumors**
Clinical Context and Therapy Purpose
The purpose of autologous stem cell transplantation in patients who have previously untreated germ cell tumors is to provide a treatment option that is an alternative to or an improvement on existing therapies.

The question addressed in this evidence review is: Does autologous stem cell transplantation used as treatment of previously untreated germ cell tumors improve net health outcomes?

The following PICO was used to select literature to inform this review.

Patients
The relevant population(s) of interest is patients with previously untreated germ cell tumors.

Interventions
The therapy being considered is autologous stem cell transplantation. Stem cell transplantation is performed in tertiary inpatient settings with specialized expertise.

Comparators
The following practices are currently being used to make decisions about the treatment of previously untreated germ cell tumors. Therapy for germ cell tumors is generally dictated by stage, risk subgroup, and tumor histology. Testicular cancer is divided into seminomatous and nonseminomatous types for treatment planning because seminomas are more sensitive to radiotherapy. Stage I testicular seminomas may be treated by orchiectomy with or without radiation or single-dose carboplatin adjuvant therapy. Nonseminomatous stage I testicular tumors may be treated with orchiectomy with or without retroperitoneal lymph node dissection. Higher stage disease typically involves treatment that incorporates chemotherapy. First-line chemotherapy for good- and intermediate-risk patients with higher stage disease is usually 3 or 4 cycles of a regimen combining cisplatin and etoposide, with or without bleomycin depending on histology and risk group. Chemotherapy is often followed by surgery to remove residual masses. Second-line therapy often consists of combined therapy with ifosfamide/mesna and cisplatin, plus vinblastine, paclitaxel, or etoposide (if not used for first-line treatment). Patients whose tumors are resistant to cisplatin may receive carboplatin-containing regimens. The probability of long-term continuous complete remission diminishes with each successive relapse.

Outcomes
The general outcomes of interest are overall survival (OS), disease-specific survival (DSS), change in disease status, treatment-related mortality (TRM).

Patients with previously untreated germ cell tumors have been considered for stem cell transplantation in the setting of remission after induction therapy. If a transplant were to be performed follow-up would be intensive weekly to monthly
surveillance during the first year after transplant and life-long if there is a successful transplant.

**Study Selection**
Methodologically credible studies were selected using the following principles:

a. To assess efficacy outcomes, comparative controlled prospective trials were sought, with a preference for RCTs;
b. In the absence of such trials, comparative observational studies were sought, with a preference for prospective studies.
c. To assess long-term outcomes and adverse effects, single-arm studies that capture longer periods of follow-up and/or larger populations were sought.
d. Studies with duplicative or overlapping populations were excluded.

**Randomized Clinical Trials**
Daugaard et al (2011) reported on the outcomes of a randomized phase 3 study comparing standard-dose cisplatin, etoposide, and bleomycin (BEP) with sequential high-dose cisplatin, etoposide, and ifosfamide plus stem cell support in previously untreated males with poor-prognosis germ cell cancer. The trial aimed to recruit 222 patients but closed with 137 patients from 27 European oncology centers due to slow accrual. Patients were ages 15 to 50 years and had previously untreated metastatic poor-prognosis nonseminomatous germ cell tumor of testicular or extragonadal origin. Median follow-up was 4.4 years; 66 patients in the BEP group and 65 patients in the transplant group were included in the analysis. Toxicity was more severe in patients who received high-dose chemotherapy (HDC), and toxicity-related deaths were reported for 2 patients who received HDC and in 1 patient in the BEP arm. There was no improvement in complete response (CR) rate in the HDC arm (44.6%) versus the standard-dose arm (33.3%; p=0.18). There was no difference in failure-free survival between the 2 groups. At 2 years, failure-free survival rates were 44.8% (95% confidence interval [CI], 32.5% to 56.4%) and 58.2% (95% CI, 48.0% to 71.9%), respectively, for the standard- and high-dose arms. The difference was not statistically significant (p=0.06). The OS did not differ between groups (p>0.1).

Motzer et al (2007) reported on a phase 3 prospective, randomized, multicenter trial of 219 previously untreated patients with poor-prognosis germ cell tumors. Median patient age was 28 years. Patients were randomized to conventional chemotherapy (4 cycles of BEP; n=111) or 2 cycles of BEP followed by 2 cycles of HDC with autologous HCT. Median follow-up was 51 months. The 1-year durable CR rate was 52% after BEP plus HDC with HCT, and 48% after BEP alone (p=0.53). There was no survival difference at 106 months for patients treated with HDC and HCT (68%) compared with patients treated with conventional chemotherapy (69%).

Droz et al (2007) assessed the impact of HDC plus HCT on the survival of patients with high-volume, previously untreated, metastatic nonseminomatous germ cell
tumors. Patients were randomized to 4 cycles every 21 days of vinblastine, etoposide, cisplatin, and bleomycin (n=57) or a slightly modified regimen followed by HDC plus autologous HCT (n=57). In an intention-to-treat analysis, the CR rates were 56% and 42% for the conventional and HDC groups, respectively (p=0.099). Median follow-up was 9.7 years, and no significant difference in OS between groups (p=0.167).

**Section Summary: Autologous HCT as First-Line Therapy for Germ Cell Tumors**

The evidence from several randomized trials found that autologous HCT as first-line therapy for germ cell tumors did not significantly improve outcomes compared with alternative therapy (eg, standard-dose chemotherapy). However, study sample sizes were relatively small and might have been underpowered to detect differences between groups. The evidence is insufficient to determine the effects of the technology on health outcomes.

**Autologous Hematopoietic Stem Cell Transplant for Relapsed or Refractory Germ Cell Tumors**

**Clinical Context and Therapy Purpose**

The purpose of autologous stem cell transplantation in patients who have relapsed or refractory germ cell tumors is to provide a treatment option that is an alternative to or an improvement on existing therapies.

The question addressed in this evidence review is: Does autologous stem cell transplantation used as treatment of relapsed or refractory germ cell tumors improve net health outcomes?

The following PICO was used to select literature to inform this review.

**Patients**

The relevant population(s) of interest is patients with relapsed or refractory germ cell tumors.

**Interventions**

The therapy being considered is autologous stem cell transplantation.

Stem cell transplantation is performed in tertiary inpatient settings with specialized expertise.

**Comparators**

The following practices are currently being used to make decisions about the treatment of previously untreated germ cell tumors. Therapy for germ cell tumors is generally dictated by stage, risk subgroup, and tumor histology. Testicular cancer is divided into seminomatous and nonseminomatous types for treatment planning because seminomas are more sensitive to radiotherapy. Stage I testicular seminomas may be treated by orchiectomy with or without radiation or single-dose carboplatin adjuvant therapy. Nonseminomatous stage I testicular tumors
may be treated with orchiectomy with or without retroperitoneal lymph node dissection. Higher stage disease typically involves treatment that incorporates chemotherapy. First-line chemotherapy for good- and intermediate-risk patients with higher stage disease is usually 3 or 4 cycles of a regimen combining cisplatin and etoposide, with or without bleomycin depending on histology and risk group. Chemotherapy is often followed by surgery to remove residual masses. Second-line therapy often consists of combined therapy with ifosfamide/mesna and cisplatin, plus vinblastine, paclitaxel, or etoposide (if not used for first-line treatment). Patients whose tumors are resistant to cisplatin may receive carboplatin-containing regimens. The probability of long-term continuous complete remission diminishes with each successive relapse.

Outcomes
The general outcomes of interest are OS, DSS, change in disease status, TRM.

If a transplant were to be performed follow-up would be intensive weekly to monthly surveillance during the first year after transplant and life-long if there is a successful transplant.

Study Selection
Methodologically credible studies were selected using the following principles:

a. To assess efficacy outcomes, comparative controlled prospective trials were sought, with a preference for RCTs;
b. In the absence of such trials, comparative observational studies were sought, with a preference for prospective studies.
c. To assess long-term outcomes and adverse effects, single-arm studies that capture longer periods of follow-up and/or larger populations were sought.
d. Studies with duplicative or overlapping populations were excluded.

Randomized Controlled Trials
Pico et al (2005) reported on a randomized trial comparing 4 cycles of conventional-dose chemotherapy with 3 cycles of the same regimen followed by carboplatin-based HDC plus autologous HCT in 280 patients who had relapsed after a complete or partial remission following first-line therapy with a cisplatin-based regimen. The authors reported no significant differences between treatment arms in 3-year event-free survival or OS. However, the trial began before international consensus had established the current risk group definitions; thus, Pico et al (2005) likely included patients now considered to have a good prognosis at relapse. Furthermore, while 77% and 86% of patients in the control and experimental arms, respectively, had at least 1 elevated serum tumor marker, they did not report how highly elevated rates were or compare arms with respect to the marker thresholds that presently determine risk level (S1-3). Finally, HDC in the experimental arm followed 3 cycles of conventional-dose chemotherapy, which differs from most current practice in the United States, in which a single cycle is used before HDC. As a consequence, 38 (28%) of 135 patients randomized to the HDC arm did not receive HDC because of progression, toxicity, or withdrawal of consent.
Case Series
Zschäbitz et al (2018) reported a retrospective analysis of the experience of 2 referral centers using high-dose chemotherapy and autologous stem cell transplantation (HDCT/ASCT) for relapsed or refractory germ cell tumors. Forty-six patients treated with HDCT/ASCT between 2000-2016 were identified; 52% of whom were categorized as poor-risk by the International Prognostic Factors Study Group prognosis score. HDCT/ASCT was performed as the first salvage regimen in 67% of patients. Further consolidation therapy after HDCT/ASCT was performed with 41% of patients undergoing resection of the residual tumor. In patients who were in complete remission after HDCT/ASCT and in those who received residual tumor resection or radiotherapy as consolidation median progression-free survival was 17.7 months (range 2-185; 95% CI: n.a.) and median OS had not been reached with 64% of patients being alive at a median follow-up time of 41 months. Median PFS and OS in patients who did not achieve a CR was 3.3 months (95% CI: 1.0-5.5) and 6.4 months (95% CI: 5.6-7.2) in those who had no further consolidation treatment.

Adra et al (2017) reported a retrospective analysis of a single-institution experience of using HDCT/ASCT for relapsed or refractory germ cell tumors. Between 2004 and 2014, there were 364 consecutive patients with germ cell tumors who progressed after cisplatin-based combination chemotherapy; 341 received 2 consecutive courses of HDCT consisting of 700 mg/m2 carboplatin and 750 mg/m2 etoposide, each for 3 consecutive days, and each followed by peripheral blood stem cell transplant. At a median follow-up of 3.3 years, patients with pure seminoma had the highest cure rate, with a 2-year PFS of 90% (95% CI, 81% to 95%). Remissions were achieved in poor-prognosis patients who received HDCT as third-line or subsequent therapy (2-year PFS, 49%) and in patients with platinum-refractory disease (2-year PFS, 33%). Adverse events were notable with 9 treatment-related deaths due to infectious complications, hepatic failure, and secondary leukemia.

Nieto et al (2015) reported on 43 male patients with poor-risk relapsed or refractory germ cell tumors who received HDC and autologous HCT. Primary tumors were testicular in 32 patients, mediastinal in 7 patients, and retroperitoneal in 4 patients. Median follow-up was 46 months (range, 9-84 months). At follow-up, the relapse-free survival rate was 55.8% and the OS rate was 58.1%. Relapse-free survival rates were 66% in patients with testicular primaries, 28.5% in patients with mediastinal primaries, and 25% in patients with retroperitoneal primaries.

Baek et al (2013) reported on results of a small feasibility study of HDC followed by HCT for patients with relapsed or progressed central nervous system (CNS) germ cell tumors. Investigators enrolled 11 patients with nongerminomatous (ie, nonseminomatous) germ cell tumors and 9 patients with germinomatous stem cell tumors, all of whom had received conventional chemotherapy with or without radiotherapy before HCT. Sixteen patients received an initial course of HDC with carboplatin, thiopental, and etoposide followed by HCT, and 9 of them received a
second course of HDC with cyclophosphamide-melphalan followed by a second HCT (see the tandem and sequential HCT for germ cell tumors section next). Twelve patients remained alive at a median follow-up of 47 months (range, 22-90 months), with a 3-year OS probability estimate of 59.1%.

Seftel et al (2011) conducted a multicenter study of consecutive patients undergoing a single autologous HCT for germ cell tumor between 1986 and 2004. For 71 subjects, median follow-up was 10.1 years. Median age was 31 years (range, 16-58 years). Sixty-seven patients had nonseminomatous germ cell tumors and 4 had seminomatous germ cell tumors. Fifty-seven patients had primary gonadal disease and 14 had primary extragonadal disease. Of the latter, 11 patients presented with primary mediastinal disease, 2 presented with primary CNS disease, and 1 presented with retroperitoneal disease. In all, 28 patients underwent autologous HCT for relapsed disease after achieving an initial CR. Of these, 24 patients underwent autologous HCT after first relapse and 4 underwent transplant after a second relapse. An additional 36 patients achieved only an incomplete response after initial therapy and proceeded to autologous HCT after salvage chemotherapy for active residual disease. The OS rate at 5 years was 44.7% (95% CI, 32% to 56.5%) and the EFS rate was 43.5% (95% CI, 31.4% to 55.1%). There were 7 (10%) treatment-related deaths within 100 days of transplant. Three (4.2%) patients developed secondary malignancies. Of 33 relapses, 31 occurred within 2 years of the transplant. Two very late relapses occurred 13 and 11 years after transplant. In a multivariate analysis, a favorable outcome was associated with International Germ Cell Consensus Classification good prognosis disease at diagnosis, primary gonadal disease, and response to salvage chemotherapy.

Agarwal et al (2009) reported on their experience at a single-center in treating 37 consecutive patients who received HDC and autologous HCT between 1995 and 2005 for relapsed germ cell tumors. Median patient age was 28 years (range, 9-59 years), with 34 males and 3 females. Primary tumor sites included 24 testes/adnexal, 10 chest/neck/retroperitoneal, and 3 CNS. Twenty-nine patients had received prior standard salvage chemotherapy. The 3-year OS rate was 57% (95% CI, 41% to 71%), and the 3-year PFS rate was 49% (95% CI, 33% to 64%).

**Section Summary: Autologous HCT for Relapsed or Refractory Germ Cell Tumors**

The single published RCT did not find improved outcomes with HDC and autologous HCT compared with standard-dose HCT. Case series had a wide range of sample sizes. Progression-free and OS rates varied by prior treatment experience, prognostic factors, number of HDCT/ASCT cycles and whether additional consolidation treatment such as radiation therapy was included. However, 2- and 3-year progression-free survival rates of 50-60% have consistently been achieved. The evidence is insufficient to determine the effects of the technology on health outcomes.
Tandem Autologous Hematopoietic Stem Cell Transplant and Sequential High Dose Chemotherapy for Germ Cell Tumors

Clinical Context and Therapy Purpose
The purpose of tandem autologous stem cell transplantation in patients who have germ cell tumors is to provide a treatment option that is an alternative to or an improvement on existing therapies.

The question addressed in this evidence review is: Does tandem autologous stem cell transplantation used as treatment of germ cell tumors improve net health outcomes?

The following PICO was used to select literature to inform this review.

Patients
The relevant population(s) of interest is patients with germ cell tumors.

Interventions
The therapy being considered is tandem autologous stem cell transplantation including the use of sequential HDC.

Stem cell transplantation is performed in tertiary inpatient settings with specialized expertise.

Comparators
The following practices are currently being used to make decisions about treatment of previously untreated germ cell tumors: surgery, chemotherapy, radiation, and chemoradiation.

Outcomes
The general outcomes of interest are OS, DSS, change in disease status, TRM.

If a transplant were to be performed, the follow-up would be intensive weekly to monthly surveillance during the first year after transplant and life-long if there is a successful transplant.

Study Selection
Methodologically credible studies were selected using the following principles:

a. To assess efficacy outcomes, comparative controlled prospective trials were sought, with a preference for RCTs;
b. In the absence of such trials, comparative observational studies were sought, with a preference for prospective studies.
c. To assess long-term outcomes and adverse effects, single-arm studies that capture longer periods of follow-up and/or larger populations were sought.
Randomized Controlled Trials

Lorch et al (2007) compared single with sequential HDC plus autologous HCT as first or subsequent salvage treatment in patients with relapsed or refractory germ cell tumors. Patients were randomized to 2 different HDC regimens (arm A, arm B). Most tumors were gonadal primaries; 10% of patients in arm A had retroperitoneal, mediastinal, or CNS primaries, and 11% of patients in arm B had retroperitoneal or mediastinal primaries. This represented the first salvage therapy received for 86% of the patients in arm A and 85% in arm B, whereas 14% in arm A and 15% in arm B had received one or more previous salvage regimens before randomization. A total of 111 (51%) of 216 patients were randomized to sequential high-dose therapy, and 105 (47%) of 216 patients were randomized to single high-dose therapy. The trial was stopped prematurely after recruitment of 216 patients as a result of excess TRM in arm B (sequential). There was a planned interim analysis after the inclusion of 50% of the required total number of patients. Survival analyses were performed on an intention-to-treat basis.

At a median follow-up of 36 months, 109 (52%) of 211 patients were alive, and 91 (43%) of 211 patients were progression-free. At 1 year, event-free survival, PFS, and OS rates were 40%, 53%, and 80%, respectively, in arm A compared with 37%, 49%, and 61%, respectively, in arm B (p>0.05 for all comparisons). Survival rates were not reported separately by primary tumor site. No difference in survival probabilities was found between the single and sequential high-dose regimens; however, sequential high-dose therapy was better tolerated and resulted in fewer treatment-related deaths. Treatment-related deaths, mainly from sepsis and cardiac toxicity, were less frequent in arm A (4/108 [4%] patients) than in arm B (16/103 [16%] patients; p<0.01). The authors attributed the higher rate of treatment-related deaths in arm B to the higher dosages per HCT cycle in the arm B regimen compared with arm A, as well as the toxic renal and cardiac effects of cyclophosphamide used in arm B.

Lorch et al (2012) reported long-term results from this trial; 5-year PFS rates were 47% (95% CI, 37 to 56%) in arm A and 45% (95% CI, 35 to 55%) in arm B (hazard ratio, 1.16; 95% CI, 0.79 to 1.70; p=0.454). Five-year OS rates were 49% (95% CI, 40 to 59%) in arm A and 39% (95% CI, 30 to 49%) in arm B (hazard ratio=1.42; 95% CI, 0.99 to 2.05; p=0.057). The authors concluded that patients with relapsed or refractory germ cell tumors could achieve durable long-term survival after single as well as tandem HCT plus sequential HDC and that fewer early deaths related to toxicity translated into superior long-term OS after HCT plus sequential HDC.

Nonrandomized Clinical Trials

Lotz et al (2005) reported on the results of a phase 2 study on 3 consecutive cycles of HDC regimens supported by autologous HCT in 45 poor-prognosis patients with relapsed germ cell tumors. From 1998 to 2001 (median follow-up, 31.8 months), 45 patients (median age, 28 years) were enrolled. Most patients (76%) had testicular primaries; 13% had mediastinal primaries; 11% had...
retroperitoneal, hepatic, or unknown. Of all patients, 22 received the complete course. Twenty-five patients died from disease progression and 5 from treatment toxicity. The overall response rate was 37.7%, including an 8.9% CR rate. Median OS was 11.8 months. The 3-year OS and PFS rates were both 23.5%. Authors used the Beyer prognostic score to predict the outcome of HDC and concluded that patients with a Beyer score greater than 2 did not benefit from this approach, confirming that highly refractory patients and particularly patients with resistant or refractory primary mediastinal germ cell tumors do not benefit from HDC.

**Observational Studies**

Lazarus et al (2007) reported on the results of autologous HCT for relapsed testicular/germ cell cancer using registry data from the Center for International Blood and Marrow Transplant Research. Patients with mediastinal primaries were excluded. Data included 300 patients from 76 transplant centers in 8 countries who received a single or a tandem autologous HCT between 1989 and 2001. Of the 300 patients, 102 received tandem and 198 received single planned autologous HCT. PFS and OS rates at 1, 3, and 5 years were similar for both groups. The probability of PFS at 5 years for the tandem transplant group was 34% (95% CI, 25% to 44%) versus 38% (95% CI, 31% to 45%) for the single transplant group (p=0.50). The probability of 5-year OS was 35% (95% CI, 25% to 46%) versus 42% (95% CI, 35% to 49%), respectively (p=0.29).

Einhorn et al (2007) reported retrospectively on a series of 184 patients, treated between 1996 and 2004, with 2 consecutive cycles of HDC for metastatic testicular cancer that had progressed (relapsed) after receiving cisplatin-containing combination chemotherapy. Patients with primary mediastinal nonseminomatous germ cell tumors or tumors with late relapse (³2 years after previous therapy) were excluded. The patient population included those with initial International Germ Cell Consensus Classification stage defined as low-risk (39%), intermediate-risk (21%), and high-risk (41%) and both platinum-sensitive and refractory disease at the beginning of HDC. Results from this experienced center showed that, of the 184 patients, 116 had complete remission of disease without relapse during a median follow-up of 48 months. Of the 135 patients who received the treatment as second-line therapy (ie, first salvage setting), 94 (70%) were disease-free during follow-up; 22 (45%) of 49 patients who received treatment as third-line or later therapy were disease-free. Of 40 patients with cancer refractory to standard-dose platinum, 18 (45%) were disease-free. Caveats to the Einhorn et al (2007) study included the lack of a validation set for the prognostic scoring system used; the unanswered question of the role of high-dose versus conventional-dose chemotherapy in the first salvage setting; and the lack of a universally accepted prognostic scoring system in this setting.

In a subsequent study from the same center as the Einhorn et al (2007) study, Suleiman et al (2013) evaluated outcomes for 12 patients with recurrent primary mediastinal nonseminomatous germ cell tumors after initial treatment with cisplatin-containing combination chemotherapy, a population excluded from their previous study, who were treated with tandem HCT. Patients received 2 consecutive courses of HDC (carboplatin and etoposide) followed by HCT. Overall
outcomes were poor, with a median survival of 11 months (range, 4-52 months), but 3 of 12 patients achieved a CR. One patient remained disease-free at 50 months of follow-up, and 1 remained disease-free after tandem HCT and subsequent mediastinal surgery at 52 months of follow-up.

Pal et al (2013) reported on 5-year follow-up results for 48 patients with relapsed germ cell tumors enrolled in a retrospective case series to evaluate the effectiveness of 2 sequential cycles of chemotherapy with paclitaxel, etoposide, and carboplatin in the first cycle, high-dose paclitaxel, ifosfamide, and carboplatin in the second, followed by HCT.18 Forty-three (91.5%) patients had nonseminomatous histology. Most patients (n=39) had received 2 prior chemotherapy regimens; 6 patients had received 3 prior regimens. Thirty-four patients had intermediate-risk classification by the Beyer score and the remainder had a high-risk classification. Of the 48 patients enrolled, 17 received only 1 course of paclitaxel, etoposide, and carboplatin, 11 were due to progressive disease, 5 due to toxicities, and 1 due to a severe fungal infection. Seventeen of the 48 patients enrolled were alive and progression-free at a median of 123.2 months (range, 51.6-170.2 months); 25 died, most (n=23) due to disease progression. Of the 23 patients alive after receiving per-protocol therapy, 18 were contacted for interviews at a median 115.6 months (range, 38.9-185.9 months) post-enrollment and underwent a cancer-related quality-of-life assessment with the European Organization for the Research and Treatment of Cancer Quality of Life Questionnaire Core 30. The overall average score on the questionnaire was 87.04; the authors compared quality-of-life scores in this cohort with a separate cohort of 150 patients who had germ cell tumors who received chemotherapy; authors reported that patients in their cohort had significantly higher global health scores (87.04 vs. 75.62, p=0.02), but lower physical functioning scores (68.9 vs. 92.7, p<0.001). The authors concluded that tandem HDC followed by HCT would be a reasonable treatment option for relapsed germ cell tumors, with long-term survivors demonstrating a reasonable quality of life.

A 2012 comparative effectiveness review, conducted for the Agency for Healthcare Research and Quality, on the use of HCT in the pediatric population concluded that, for germ cell tumors, the body of evidence on OS with tandem HCT compared with single HCT was insufficient to draw conclusions.19

Section Summary: Tandem Autologous HCT and Sequential HDC for Germ Cell Tumors

One RCT compared tandem HCT with single versus sequential HDC for germ cell tumors. This RCT showed higher TRM with sequential HDC than with single HDC. Five-year survival outcomes, however, did not show significant differences between groups. Observational studies have included heterogeneous patient populations, in different salvage treatment settings (ie, first vs. subsequent salvage therapy), and lacked a universally accepted prognostic scoring system to risk-stratify patients. The evidence is insufficient to determine the effects of the technology on health outcomes.
**Allogeneic Hematopoietic Stem Cell Transplant for Germ Cell Tumors**

No RCTs or nonrandomized comparative studies evaluating allo-HCT for germ cell tumors were identified. One 2007 case report has described successful treatment of a refractory mediastinal germ cell tumor with allo-HCT.

**Section Summary: Allo-HCT for Germ Cell Tumors**

There is a lack of comparative studies evaluating allo-HCT for germ cell tumors. Only a single case report was identified.

**Summary of Evidence**

For individuals who have previously untreated germ cell tumors who receive autologous HCT as first-line therapy, the evidence includes RCTs The relevant outcomes are overall survival (OS), disease-specific survival (DSS), and treatment-related mortality (TRM) and morbidity. Results from the RCTs have shown that autologous HCT as initial therapy for germ cell tumors did not significantly improve outcomes compared with alternative therapy (eg, standard-dose chemotherapy). Study sample sizes were relatively small and might have been underpowered to detect differences between groups. The evidence is insufficient to determine the effects of the technology on health outcomes.

For individuals who have relapsed or refractory germ cell tumors who receive autologous HCT, the evidence includes an RCT and several case series. The relevant outcomes are OS, DSS, and TRM and morbidity. The single published RCT did not find improved outcomes with high-dose chemotherapy (HDC) and autologous HCT compared with standard-dose HCT. Case series had a wide range of sample sizes. Progression-free and OS rates varied by prior treatment experience, prognostic factors, number of high-dose chemotherapy and autologous stem cell transplantation cycles and whether additional consolidation treatment such as radiation therapy was included. However, 2- and 3-year progression-free survival rates of 50-60% have consistently been achieved. The evidence is insufficient to determine the effects of the technology on health outcomes.

For individuals who have germ cell tumors who receive tandem autologous transplantation and sequential HDC, the evidence includes an RCT, several retrospective cohort studies, and a comparative effectiveness review. The relevant outcomes are OS, DSS, and TRM and morbidity. The RCT reported a higher rate of TRM with sequential HDC compared with single HDC. However, 5five-year survival outcomes did not differ significantly between groups. Overall, the available studies have included heterogeneous patient populations, in different salvage treatment settings (ie, first vs. subsequent salvage therapy), and have lacked a universally accepted prognostic scoring system to risk-stratify patients. Tandem autologous transplant or transplant with sequential HDC has not shown a benefit in patients with primary mediastinal germ cell tumors. The evidence is insufficient to determine the effects of the technology on health outcomes. However, clinical input supported the use of this approach to salvage treatment.
For individuals who have germ cell tumors who receive allogeneic HCT, the evidence includes a case report. The relevant outcomes are OS, DSS, and TRM and morbidity. There were no RCTs or nonrandomized comparative studies evaluating allogeneic HCT for germ cell tumors. One 2007 case report has described successful treatment of a refractory mediastinal germ cell tumor with allogeneic HCT. The evidence is insufficient to determine the effects of the technology on health outcomes.

SUPPLEMENTAL INFORMATION

Clinical Input From Physician Specialty Societies 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.

In response to requests, input was received from 3 physician specialty societies, 3 academic medical centers, and 5 Blue Distinction Centers for Transplants while this policy was under review in 2010. There was general agreement with the policy statements regarding the use of single autologous hematopoietic cell transplantation (HCT) as salvage therapy, the use of autologous HCT as first-line treatment, and the use of allogeneic HCT. Seven reviewers felt that tandem autologous transplant or transplant with sequential HCT is medically necessary for patients as salvage therapy or with platinum-refractory disease; 2 reviewers felt that tandem transplant or sequential high-dose chemotherapy was investigational.

Practice Guidelines and Position Statements

National Comprehensive Cancer Network
Current National Comprehensive Cancer Network guidelines on testicular cancer (v.2.2020) state that second-line chemotherapy regimens for metastatic germ cell tumors include high-dose chemotherapy with stem cell support.21

American Society for Blood and Marrow Transplantation
The guidelines by the American Society for Blood and Marrow Transplantation (2015) were published on indications for autologous and allogeneic HCT. Recommendations were intended to describe the current consensus on the use of HCT within and outside of the clinical trial setting.22 Recommendations on germ cell tumors are listed in Table 1.

Table 1. Recommendations on Allogeneic and Autologous HCT

<table>
<thead>
<tr>
<th>Indications</th>
<th>Allogeneic HCT</th>
<th>Autologous HCT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pediatric</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Germ cell tumor, relapse</td>
<td>D</td>
<td>C</td>
</tr>
</tbody>
</table>
Germ cell tumor, refractory | D | C
Adult
Germ cell tumor, relapse | N | C
Germ cell tumor, refractory | N | C

C: clinical evidence available, standard of care; D: developmental (ie promising); HCT: hematopoietic cell transplantation N: not generally recommended.

**U.S. Preventive Services Task Force Recommendations**
Not applicable.

**Medicare National Coverage**
There is no national coverage determination. In the absence of a national coverage determination, coverage decisions are left to the discretion of local Medicare carriers.

**Ongoing and Unpublished Clinical Trials**
Some currently unpublished trials that might influence this policy are listed in Table 2.

**Table 2. Summary of Key Trials**

<table>
<thead>
<tr>
<th>NCT No.</th>
<th>Trial Name</th>
<th>Planned Enrollment</th>
<th>Completion Date</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Ongoing</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NCT00432094</td>
<td>Autologous Peripheral Blood Stem Cell Transplant for Germ-Cell Tumors</td>
<td>25</td>
<td>Jan 2020</td>
</tr>
<tr>
<td>NCT00936936</td>
<td>High-dose Chemotherapy for Poor-prognosis Relapsed Germ-cell Tumors</td>
<td>68</td>
<td>Nov 2019</td>
</tr>
<tr>
<td>NCT02375204</td>
<td>Standard Dose Chemotherapy or High-Dose Chemotherapy and Stem Cell Transplant in Treating Patients with Relapsed or Refractory Germ Cell Tumors</td>
<td>420</td>
<td>Jun 2024</td>
</tr>
</tbody>
</table>

NCT: national clinical trial.

**REFERENCES**


**Billing Coding/Physician Documentation Information**

- **38204** Management of recipient hematopoietic progenitor cell donor search and cell acquisition
- **38205** Blood-derived hematopoietic progenitor cell harvesting for transplantation, per collection; allogeneic
- **38206** Blood-derived hematopoietic progenitor cell harvesting for transplantation, per collection; autologous
- **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
- **38230** Bone marrow harvesting for transplantation; allogeneic
- **38232** Bone marrow harvesting for transplantation; autologous
- **38240** Hematopoietic progenitor cell (HPC); allogeneic transplantation per donor
- **38241** Hematopoietic progenitor cell (HPC); autologous transplantation
- **38242** Allogeneic lymphocyte infusions
- **38243** Hematopoietic progenitor cell (HPC); HPC boost
- **86812** HLA typing; A, B, or C, single antigen
- **86813** HLA typing; A, B, or C, multiple antigens
- **86816** HLA typing; DR/DQ single antigen
- **86817** HLA typing; DR/DQ multiple antigens
- **86821** HLA typing; lymphocyte culture, mixed (MLC)
- **86822** HLA typing; lymphocyte culture, primed (PLC) (Code deleted 12/31/17)
- **Q0083** Chemotherapy administration by other than infusion technique only (e.g., subcutaneous, intramuscular, push), per visit
- **Q0084** Chemotherapy administration by infusion technique only, per visit
- **Q0085** Chemotherapy administration by both infusion technique and other technique(s) (e.g., subcutaneous, intramuscular, push), per visit
- **S2140** Cord blood harvesting for transplantation, allogeneic
- **S2142** Cord blood-derived stem cell transplantation, allogeneic
S2150  Bone marrow or blood-derived peripheral stem cell harvesting and transplantation, allogeneic or autologous, including pheresis, high-dose chemotherapy, and 28 days of post-transplant care (including drugs; hospitalization; medical surgical, diagnosis and emergency services)

**ICD-10 Codes**

- **C38.1-C38.3**: Malignant neoplasm of mediastinum code range
- **C48.0**: Malignant neoplasm of retroperitoneum
- **C56.1-C56.9**: Malignant neoplasm of ovary code range
- **C62.0-C62.92**: Malignant neoplasm of testis, code range
- **C75.3**: Malignant neoplasm of pineal gland

**Additional Policy Key Words**

N/A

**Policy Implementation/Update Information**

- **7/1/02**  New policy added to the Medical section.
- **8/1/03**  No policy statement changes.
- **7/1/04**  No policy statement changes.
- **7/1/05**  No policy statement changes.
- **4/1/06**  Considerations section revised to include general criteria.
- **7/1/06**  No policy statement changes.
- **7/1/07**  Description and medically necessary policy statement reworded regarding poor-risk germ-cell tumors; however, policy statements are otherwise unchanged.
- **7/1/08**  No policy statement changes.
- **7/1/09**  Terminology in policy statements changed; however, no change in intent of policy statements. “High-dose chemotherapy” removed from title.
- **7/1/10**  Policy statements revised to indicate that tandem-sequential autologous SCT may be considered medically necessary in certain types of testicular cancers.
- **7/1/11**  Minor change to policy statements (deleted statement “Except as noted above for treatment of certain testicular tumors, tandem or sequential autologous hematopoietic stem-cell transplantation is considered investigational to treat germ-cell tumors of any stage.”)
- **7/1/12**  No policy statement changes.
- **7/1/13**  No policy statement changes.
- **7/1/14**  Updated description on CPT 38240, 38241, and added CPT 38242, 38243. No policy statement changes.
- **7/1/15**  No policy statement changes.
- **7/1/16**  Added CPT 38230, 38232. No policy statement changes.
- **7/1/17**  Changed “hematopoietic stem cell transplantation” to “hematopoietic
cell transplantation” per NCCN terminology change. Policy statements unchanged.

4/1/18 One policy statement was reworded, from “Tandem or sequential autologous HCT may be considered medically necessary for the treatment of testicular tumors either as salvage therapy or with platinum-refractory disease” to “Tandem autologous HCT or transplant with sequential high-dose chemotherapy may be considered medically necessary for the treatment of testicular tumors either as salvage therapy or with platinum-refractory disease.”

7/1/18 No policy statement changes.
7/1/19 No policy statement changes.
7/1/20 No policy statement changes.

State and Federal mandates and health plan contract language, including specific provisions/exclusions, take precedence over Medical Policy and must be considered first in determining eligibility for coverage. The medical policies contained herein are for informational purposes. The medical policies do not constitute medical advice or medical care. Treating health care providers are independent contractors and are neither employees nor agents Blue KC and are solely responsible for diagnosis, treatment and medical advice. No part of this publication may be reproduced, stored in a retrieval system or transmitted, in any form or by any means, electronic, photocopying, or otherwise, without permission from Blue KC.