Extracorporeal Photopheresis

Policy # 00099
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Applies to all products administered or underwritten by Blue Cross and Blue Shield of Louisiana and its subsidiary, HMO Louisiana, Inc. (collectively referred to as the “Company”), unless otherwise provided in the applicable contract. Medical technology is constantly evolving, and we reserve the right to review and update Medical Policy periodically.

When Services Are Eligible for Coverage
Coverage for eligible medical treatments or procedures, drugs, devices or biological products may be provided only if:
- Benefits are available in the member’s contract/certificate, and
- Medical necessity criteria and guidelines are met.

Based on review of available data, the Company may consider extracorporeal photopheresis (ECP) to treat cardiac allograft rejection, including acute rejection, that is either recurrent or that is refractory to standard immunosuppressive drug treatment to be eligible for coverage.

Based on review of available data, the Company may consider extracorporeal photopheresis (ECP) as a technique to treat acute graft-versus-host disease (GVHD) that is refractory to medical therapy to be eligible for coverage.

Based on review of available data, the Company may consider extracorporeal photopheresis (ECP) as a technique to treat chronic graft-versus-host disease (GVHD) that is refractory to medical therapy to be eligible for coverage.

Based on review of available data, the Company may consider extracorporeal photopheresis (ECP) as a technique to treat late-stage (III/IV) cutaneous T-cell lymphoma (CTCL) to be eligible for coverage.

Based on review of available data, the Company may consider extracorporeal photopheresis (ECP) as a technique to treat either the cutaneous or visceral manifestations of autoimmune diseases, including but not

When Services Are Considered Investigational
Coverage is not available for investigational medical treatments or procedures, drugs, devices or biological products.

Based on review of available data, the Company considers extracorporeal photopheresis (ECP) in all other situations related to treatment or prevention of rejection in solid-organ transplantation to be investigational.*

Based on review of available data, the Company considers extracorporeal photopheresis (ECP) as a technique to treat acute graft-versus-host disease (GVHD) or chronic graft-versus-host disease (GVHD) that is either previously untreated or is responding to established therapies to be investigational.*

Based on review of available data, the Company considers extracorporeal photopheresis (ECP) as a technique to treat either the cutaneous or visceral manifestations of autoimmune diseases, including but not
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limited to scleroderma, systemic lupus erythematosus, rheumatoid arthritis, pemphigus, psoriasis, multiple sclerosis, diabetes, autoimmune bullous disorders, severe atopic dermatitis, or Crohn disease to be investigational.*

Based on review of available data, the Company considers extracorporeal photopheresis (ECP) as a technique to treat early stage (I/II) cutaneous T-cell lymphoma (CTCL) that is either previously untreated or is responding to established nonsystemic therapies to be investigational.*

Based on review of available data, the Company considers extracorporeal photopheresis (ECP) for all other indications to be investigational.*

Guidelines

Organ Rejection After Solid Organ Transplant
A regimen of immunosuppressive therapy is standard of care for the treatment of solid-organ rejection. Therefore, refractory rejection is defined as rejection that fails to respond adequately to a standard regimen of immunosuppressive therapy.

Recurrent allograft rejection is defined as having at least 2 rejection episodes that recurred after standard immunosuppressive therapy.

There is no standard schedule for ECP, and reported schedules vary by the organ type. However, most reported cardiac and lung schedules initiate therapy with 2 consecutive days of extracorporeal photopheresis in month 1, followed by biweekly therapy on 2 consecutive days in months 2 and 3, then monthly on 2 consecutive days in months 4 through 6.

Graft-Versus-Host Disease
Methylprednisolone is considered first-line treatment of acute GVHD. For chronic GVHD, an alternating regimen of cyclosporine and prednisone is commonly used; other therapies include antithymocyte globulin, corticosteroid monotherapy, and cytotoxic immunosuppressive drugs such as procarbazine, cyclophosphamide, or azathioprine. Therefore, refractory disease is defined as GVHD that fails to respond adequately to a trial of any of the above therapies.

Treatment schedule and duration of ECP for GVHD have not been optimally defined. Guidelines and consensus statements generally recommend 1 cycle (ie, ECP on 2 consecutive days) weekly for acute GVHD and every 2 weeks for chronic GVHD. Treatment duration is based on clinical response, discontinuation is generally recommended for no or minimal response.

Cutaneous T-cell Lymphoma Staging (based on the tumor, node, metastasis [TNM] classification system)
IA: T1N0M0
IB: T2N0M0
IIA: T1-2N1M1
IIB: T3N0-1M0

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III: T4N0-1M0
IVA: T1-4N2-3M0
IVB: T1-4N0-3M1

Sézary Syndrome
According to the World Health Organization‒European Organization for Research and Treatment of Cancer (WHO-EORTC), Sézary syndrome is defined by the triad of erythroderma, generalized lymphadenopathy, and the presence of neoplastic T cells (Sézary cells) in skin, lymph nodes, and peripheral blood. The International Society of Cutaneous Lymphomas recommends an absolute Sézary cell count of at least 1000 cells per cubic mm, in the presence of immunophenotypical abnormalities (CD4/CD8 ratio greater than 10; loss of any or all of the T-cell antigens CD2, CD3, CD4, and CD5; or both), or the demonstration of a T-cell clone in the peripheral blood by molecular or cytogenetic methods.

Background/Overview
Extracorporeal photopheresis is a leukapheresis-based immunomodulatory procedure that involves the following steps:

1. Patient blood is collected into a centrifuge system that separates the leukocyte-rich portion (buffy coat) from the rest of the blood.
2. The photosensitizer agent 8-methoxypsoralen (8-MOP) is added to the lymphocyte fraction, which is then exposed to ultraviolet (UV) A (320-400 nm wavelength) light at a dose of 1-2 J per square cm.
3. The light-sensitized lymphocytes are reinfused into the patient.

Extracorporeal photopheresis has been investigated for the treatment of patients with a variety of autoimmune diseases, GVHD, and TCL, as well as treatment for and prevention of organ rejection after solid-organ transplant.

Treatment for and Prevention of Organ Rejection after Solid-Organ Transplant
The standard of care for treatment of organ transplant rejection is immunosuppression, with the particular regimen dictated by the organ being transplanted. As organ transplantation success rates have improved, more patients are facing the morbidity and mortality associated with immunosuppressive therapies developed to prevent rejection of the transplanted organ. Immunosuppressive therapies are used to lower the responsiveness of the recipient’s immune system, decreasing the chance of rejection. Unfortunately, portions of the immune system responsible for the prevention of viral, fungal, and bacterial infection are also affected. This can, in turn, lead to serious infections, including opportunistic infections.

Although first approved for the treatment of CTCL, ECP has more recently been used as a supplement to conventional therapies in the area of solid organ transplantation. Reports of the successful use of ECP in human cardiac transplant recipients were published in 1992 and use in other transplant patients followed. Although the specific mechanism of action of ECP is unknown, the reinfusion of treated leukocytes seems to specifically suppress the patient’s immune response to the donor organ, although maintaining the body’s ability to respond to other antigens. The specificity of ECP to target the immune response to the
transplanted organ allows ECP to decrease organ rejection without an increased risk of infection, common with immunosuppressive drugs.

**Treatment of Graft-versus-Host Disease**
Extracorporeal photopheresis as a treatment of GVHD after a prior allogeneic stem-cell transplant is based on the fact that GVHD is an immunologically mediated disease. Graft-versus-host disease can be categorized into acute disease, occurring within the first 100 days after infusion of allogeneic cells, or chronic disease, which develops sometime after 100 days. Acute GVHD is commonly graded from I–IV, ranging from mild disease, which is characterized by a skin rash without involvement of the liver or gut, to grades III and IV, which are characterized by generalized erythroderma, elevated bilirubin levels, or diarrhea. Grade III acute GVHD is considered severe, while grade IV is considered life-threatening. Chronic GVHD typically presents with more diverse symptomatology resembling autoimmune diseases such as progressive systemic sclerosis, systemic lupus erythematosus, or rheumatoid arthritis. Chronic GVHD may affect the mouth, eyes, respiratory tract, musculoskeletal system, and peripheral nerves, as well as the skin, liver, or gut—the usual sites of acute GVHD.

**Treatment of Autoimmune Disease**
The use of ECP as a treatment of autoimmune disease is based on the premise that pathogenic lymphocytes form an expanded clone of cells, which are damaged when exposed to UV light in the presence of 8-MOP. It is hypothesized that the resulting damage induces a population of circulating suppressor T cells targeted against the light-damaged cells. It is further hypothesized that these suppressor T cells are targeted at a component of the cell that is common to the entire clone of abnormal cells (i.e., not just the light-sensitized cells), thus inducing a systemic effect. However, although scleroderma and other autoimmune diseases are associated with the presence of circulating antibodies, it is not certain how these antibodies are related to the pathogenesis of the disease, and, as discussed in this policy, photopheresis is not associated with consistent changes in autoantibody levels.

**Treatment of Cutaneous T-Cell Lymphoma**
According to the National Cancer Institute (NCI), CTCL is a neoplasia of malignant T lymphocytes that initially present as skin involvement. Cutaneous T-cell lymphoma is extremely rare, with an estimated incidence of approximately 0.4 per 100,000 annually but, because most are low-grade malignancies with long survival, the overall prevalence is much higher. Two CTCL variants, mycosis fungoides (MF) and the Sezary syndrome, account for approximately 60% and 5% of new cases of CTCL, respectively.

Cutaneous T-cell lymphoma is included in the Revised European-American Lymphoma classification as a group of low-grade T-cell lymphomas, which should be distinguished from other T-cell lymphomas that involve the skin, such as anaplastic large cell lymphoma, peripheral T-cell lymphoma (PTCL), adult T-cell leukemia/lymphoma (usually with systemic involvement), or subcutaneous panniculitic T-cell lymphoma. In addition, a number of benign or very indolent conditions can be confused with MF, further complicating diagnosis. See the coverage section of this policy for the current staging classification of CTCL using the TNM classification system.
Mycosis fungoides typically progress from an eczematous patch/plaque stage, covering less than 10% of the body surface (T1), to a plaque stage, covering 10% or more of the body surface (T2), and finally to tumors (T3) that frequently undergo necrotic ulceration. Sézary syndrome is an advanced form of MF with generalized erythroderma (T4) and peripheral blood involvement (B1) at presentation. Cytologic transformation from a low-grade lymphoma to a high-grade lymphoma sometimes occurs during the course of these diseases and is associated with a poor prognosis. A common cause of death during the tumor phase is sepsis from *Pseudomonas aeruginosa* or *Staphylococcus aureus* caused by chronic skin infection with staphylococcus species and subsequent systemic infections.

The natural history of MF is typically indolent. Symptoms may present for long periods, an average of 2 to 10 years, as waxing and waning cutaneous eruptions prior to biopsy confirmation. The prognosis of patients with MF/Sézary syndrome is based on the extent of disease at presentation and its stage. Lymphadenopathy and involvement of peripheral blood and viscera increase in likelihood with worsening cutaneous involvement and define poor prognostic groups. The median survival following diagnosis varies according to stage. Patients with stage IA disease have a median survival of 20 or more years, with the majority of deaths for this group typically unrelated to MF. In contrast, more than 50% of patients with stage III through stage IV disease die of their disease, with a median survival of less than 5 years.

Appropriate therapy of CTCL depends on a variety of factors, including stage, the patient's overall health, and the presence of symptoms. In general, therapies can be categorized into topical and systemic treatments that include ECP. In contrast to more conventional lymphomas, CTCL, possibly excepting ones in the earliest stages, is not curable. Thus, systemic cytotoxic chemotherapy is avoided except for advanced-stage cases. Partial or complete remission is achievable, although the majority of patients require lifelong treatment and monitoring.

**Peripheral T-Cell Lymphoma**

Peripheral T-cell lymphoma is a group of rare and usually aggressive non-Hodgkin lymphomas that develop from mature T cells. Peripheral T-cell lymphoma comprises approximately 10-15% of all cases of non-Hodgkin lymphoma in the United States and generally occur in people 60 years of age and older. Standards of care are evolving, including the use of hematopoietic stem-cell transplantation.

**FDA or Other Governmental Regulatory Approval**

**U.S. Food and Drug Administration (FDA)**

The U.S. FDA has approved via premarket application for 2 photopheresis systems manufactured by Therakos Inc. (West Chester, PA). Both systems are approved for use in ultraviolet A (UVA) irradiation treatment, in the presence of the photoactive drug 8-MOP, of extracorporeally circulating leukocyte-enriched blood, in the palliative treatment of skin manifestations of CTCL, in persons who have not been responsive to other forms of treatment. The 2 systems are:

- **CELLEX™**, FDA approved in 2009.
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8-MOP (UVADEX®) is FDA-approved for extracorporeal administration with the UVAR XTS or CELLEX Photopheresis System in the palliative treatment of the skin manifestations of CTCL that is unresponsive to other forms of treatment.

The use of either Therakos Photopheresis System or UVADEX for other conditions is an off-label use of an FDA-approved device/drug. FDA product code: LNR.

Centers for Medicare and Medicaid Services (CMS)
Organ Rejection after Solid-Organ Transplant
Based upon a 2006 evidence review, the CMS concluded that ECP is reasonable and necessary for persons with acute cardiac allograft rejection whose disease is refractory to standard immunosuppressive drug treatment.

Effective April 30, 2012, Medicare also provides coverage for ECP for the treatment of bronchiolitis obliterans syndrome (BOS) following lung allograft transplantation only when ECP is provided under a clinical research study that meets certain conditions.

Graft-versus-Host Disease
Effective December 19, 2006, Medicare provides coverage of ECP for patients with cGVHD whose disease is refractory to standard immunosuppressive drug treatment.

Autoimmune Disease
There are no national coverage decisions regarding the use of ECP for the treatment of autoimmune disease.

Cutaneous T-Cell Lymphoma
Based upon a 1988 evidence review, the CMS concluded that ECP is reasonable and necessary for palliative treatment of skin manifestations of CTCL that has not responded to other therapy.

Rationale/Source
The most recent literature review was performed with search of the MEDLINE database in March 2015. The following is a summary of the key literature to date.

Organ Rejection After Solid Organ Transplant
Cardiac
Acute Rejection
A 1992 RCT compared the efficacy of ECP with corticosteroids in the treatment of heart transplant rejection. Costanzo-Nordin and colleagues enrolled 16 heart transplant patients and randomly assigned them to either ECP (n = 9) or corticosteroids (n = 7). Recipients of orthotopic transplanted hearts were eligible if endomyocardial biopsy (EMB) showed moderate rejection (grades 2, 3A, and 3B). Participants were excluded for leukopenia, hemodynamic compromise manifested clinically or by decrease in cardiac output equal to or greater than 25% and an increase in mean pulmonary artery wedge pressure equal to or greater than 25%, and/or an allergy or intolerance to psoralen. Corticosteroids were dosed at 100 mg/day oral
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prednisone for 3 days or 1 g/day IV methylprednisolone for 3 days at the discretion of the managing physician. The treatment was repeated if EMB at day 7 showed no improvement in rejection grade. If the rejection grade persisted after retreatment, patients were given 10 mg oral methotrexate at weekly intervals for 8 weeks. Participants were followed for a mean of 6.2 months, and all participants completed the study. Extracorporeal photopheresis participants were given one ECP treatment unless an inadequate number of cells were treated. In that case, an additional treatment was given 48 hours later. Eight of the 9 rejection episodes treated with ECP improved; all 7 of rejection episodes treated with corticosteroids resolved. Improvement was seen in a mean of 7 days (range: 5–20) for ECP and 8 days (range: 6–67 days) after corticosteroid treatment. Seven infections occurred during follow-up, 5 in the corticosteroid groups and 2 among those receiving ECP. No other adverse events were observed with ECP. The authors noted the major limitations of the study included the small sample size and the wide range of time from transplant to study entry. They concluded that ECP and corticosteroids in this small group with short-term follow-up appear to have similar efficacies for the treatment of moderate heart transplant rejection. They also noted the lower number of infections with no other observed harms associated with ECP.

Recurrent, Multiple and/or Refractory Rejection

In 2006, Kirklin et al published a comparative study of 343 heart transplant recipients. Thirty-six patients were treated with ECP for rejection and formed the treatment group. Patients were 18 years of age or older, treated from 1990-1993, and followed to May 2004. Indications for ECP were episodes of rejection with hemodynamic compromise (HC) (n = 12), recurrent (n = 9) or persistent (n = 11) rejection, or as prophylaxis in the presence of anti-donor antibodies. Extracorporeal photopheresis consisted of psoralen in a 2-day treatment protocol every 3 to 6 weeks for 18 months; maintenance immunosuppression-utilized cyclosporine or tacrolimus-based therapy with prednisone for the first 4 to 6 months and azathioprine, which was replaced by mycophenolate mofetil during the later years of the study. The primary outcome was hazard rate of subsequent HC rejection after at least 1 HC had already occurred. Hazard functions were used for analysis. Patients with at least 3 months of ECP were considered to have effective photopheresis treatment; if less than 3 months, they were considered to not have had treatment but were analyzed as part of the photopheresis group. Risk factor analysis showed those who received photopheresis were at high risk for HC rejection. The period after 3 months of ECP was associated with a reduction in risk of HC rejection or rejection death (risk reduction [RR]: 0.29). A sustained decrease in the risk of HC rejection or HC death was observed for the photopheresis group through 2 years of follow-up. This study was not randomized; there was imbalance in the pretreatment risk of rejection or rejection death between the two groups. Changes in maintenance immunotherapy over time may confound the results, as patients in the comparison group did not receive a consistent regimen. However, these changes in maintenance immunotherapy would tend to make the identification of an effect of ECP created by the ever-evolving immunotherapy regimen more difficult. This only strengthens the authors’ conclusion that ECP reduces the risk of subsequent HC rejection and/or death from rejection when initiated for patients with high risk of rejection.

Dall’Amico et al. reported in 2000 on a case series of 11 patients with recurrent rejection after heart transplant. Participants were eligible if they had acute rejection and at least 2 rejection episodes in the 3 months prior to ECP, which recurred after standard immunosuppressive therapies. Extracorporeal photopheresis was performed with the UVAR photopheresis instruments, with 2 consecutive treatments at
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weekly intervals for 1 month, 2 treatments twice weekly during the second and third months, then monthly for 3 additional months. One patient, showing 3B rejection, received pulse IV corticosteroids during the first ECP cycle. Patients were followed for 60 months. During follow-up, 1 patient died from hepatitis C virus and 1 dropped out due to rejection unresponsive to ECP and high-dose corticosteroids; all others completed the study. All acute rejection episodes were successfully reversed after a mean of 14.2 days (range: 7–32 days). In terms of rejection relapse, the fraction of EMB with a grade of 0/1A increased during ECP from 46% to 72%, and those showing 3A/3B rejection decreased from 42% to 18%. One of 78 EMB during ECP showed 3B rejection compared to 13 of 110 during the pre-ECP period. Six rejection relapses were observed during follow-up, 2 during the tapering of oral corticosteroids. Four were reversed by ECP, 1 by intravenous (IV) corticosteroids, and the last by methotrexate after failure of both ECP and IV corticosteroids. Mean dose of immunosuppressive drugs (corticosteroids, cyclosporine, and azathioprine) was reduced after 6 months of ECP therapy. One patient with anemia and low body weight experienced symptomatic hypotension episodes during treatment, and 1 patient had interstitial pneumonia. The authors concluded ECP to be a well-tolerated treatment, which allows for better recurrent rejection control and significant reductions in immunosuppressive therapy. The follow-up time and patient population are adequate; the study is limited by its small size and lack of a comparison group.

Maccherini and colleagues presented a case series of 12 patients treated with ECP for recurrent rejection. Inclusion criteria were recurrent rejection (n = 5), recurrent infections associated with acute rejection (n = 2), and 3A acute rejection 2 years after transplantation (n = 5). Mean post-ECP follow-up was 23.3 months. Extracorporeal photopheresis was performed as 2 treatments per week for 1 month, once a week for 2 months, then once a month for 2 months, totaling 20 ECP treatments during 6 months. Total number of rejection episodes decreased from a mean of 3 per patient pre-ECP to 0.4 per patient post-ECP. Reduction in immunosuppressive therapy was achieved by all patients. There were no adverse effects or infections reported during follow-up. The authors concluded that ECP was safe and effective for heart transplant patients with recurrent rejection, allowing for both a reduction in rejection episodes and immunosuppressive therapy.

Similar results were presented by Lehrer and colleagues describing the experience of 4 patients treated with ECP for severe refractory (grade IIIA to IV) cardiac allograft rejection. All 4 patients experienced reversal of their rejection. Three patients improved following 2 consecutive days of treatment, and the fourth patient responded following three 2-day treatments. Two of these patients subsequently died of acute rejection at 9 weeks and 10 weeks, respectively, after completion of ECP. The other 2 were without signs of rejection, one for 6 years and the other's last report was 4 months after ECP ended. This small case series adds to the evidence provided by the prior 2 slightly larger studies.

Carlo et al (2014) reported their experience with ECP in 20 pediatric heart transplant recipients between 1990 and 2012 at the University of Birmingham in Alabama. Patients were transplanted at a median age of 12.7 years (range, 0.3–18.5) and received first ECP at a median age of 15.3 years (range, 7.3–31). Indications for ECP included rejection with HC, rejection without HC, and prophylaxis. One- and 3-year survival after ECP was 84% and 53%, respectively. Survival outcomes were worse in noncompliant patients compared with compliant patients.
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Prevention of Rejection

An RCT by Barr and colleagues investigated ECP for the prevention of rejection after cardiac transplant. Sixty consecutive adult cardiac transplant recipients at 12 clinical sites (9 U.S., 3 in Europe) were randomly assigned to both immunosuppressive therapy and ECP (n = 33) or immunosuppressive therapy alone (n = 27). Standard immunosuppressive therapy consisted of cyclosporine, azathioprine, and prednisone. To be eligible, participants needed adequate peripheral venous access and had to reside less than 2 hours away from the transplant center. Extracorporeal photopheresis treatment was delivered on days 1, 2, 5, 6, 10, 11, 17, 18, 27, and 28 in month 1; then 2 consecutive days every 2 weeks in months 2 and 3; and 2 successive days every 4 weeks for months 4 to 6 for a total of 24 ECP procedures per patient. Primary endpoint of the study was the number and frequency of histologic acute rejection episodes. Pathologists were blinded to treatment assignment. Follow-up for the primary endpoint was 6 months; an additional 6 months of follow-up was completed to assess safety and survival.

After 6 months of follow-up, the (mean [SD]) number of acute rejection episodes per patient was statistically greater in the standard therapy group (1.4 [1.0]) than in the ECP group (0.9 [1.0]). In the standard therapy group, 5 patients had no rejection episodes, 9 had one, 9 had two, and 4 had three or more. In the ECP group, 13 had none, 14 had one, 3 had two, and 3 had three or more. These differences were statistically significant. There were no differences in 6- or 12-month survival, number of infections, or time to first rejection between groups. During a subsequent 6 months of follow-up, there was no difference between groups in the number of acute rejection episodes; however, because of time management issues, institutions reverted to nonstandardized protocols during this interval. The authors concluded that ECP in addition to standard immunosuppressive therapy significantly reduced the risk of cardiac rejection without increasing the risk of infection. More long-term follow-up is necessary to see the effects of a reduction of acute rejection on long-term graft function, survival of the transplant recipient, and development of graft vasculopathy.

Lung

Acute Rejection

Villanueva and colleagues reported in 2000 on a retrospective review of data on 14 transplants (7 bilateral lung, 6 single lung, 1 heart-lung) recipients who received ECP for BOS. All patients were refractory to standard immunosuppressive therapy. Extracorporeal photopheresis was administered every 2 weeks for 2 months followed by once a month for the next 2 months for a total of 6 treatments. Four of 8 patients with initial BOS grade of 0 or 1 had improvement in BOS or stabilization of BOS after treatment. Mean survival after ECP was 14 +/- 12 months. Three of these patients received ECP during a concurrent episode of acute rejection. All 3 of these patients had complete resolution of the acute rejection following therapy. Another study published in 1999 completed by Salerno et al. reported on 2 patients with histologic reversal of concurrent acute rejection after treatment with ECP. These 2 studies reported on only 5 cases of ECP used to treat acute rejection. Additional prospective trials are needed to determine the efficacy of ECP to treat acute rejection after lung transplantation.

In 2008, Benden and colleagues published a single-center experience with ECP, which included 24 patients treated with ECP, 12 for recurrent acute rejection and 12 for BOS (see review in the next section). Patients had biopsy-confirmed chronic acute rejection, defined as 2 or more biopsy-proven episodes of acute
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rejection prior to the start of ECP. The primary outcome measure was clinical stabilization of rejection after ECP. All but one patient had follow-up biopsies during treatment; two patients had an episode of biopsy-proven acute rejection. All patients with recurrent acute rejection experienced clinical stabilization after 12 cycles of ECP; none experienced BOS. Treatment was well-tolerated with no adverse events related to ECP reported. Median patient survival was 7.0 years (range: 3.0–13.6 years), the median patient survival post-ECP was 4.9 years (range: 0.5–8.4 years). However, these rates are for the 24 patients as a whole, not broken down by indication for ECP.

Chronic Rejection Refractory to Corticosteroid/Refractory BOS

In 2013, Greer et al reported a retrospective analysis of 65 patients treated at a single institution with ECP for chronic lung allograft dysfunction, defined as deteriorating FEV1 due to BOS, as well as reduced total lung capacity and broncho-alveolar lavage neutrophilia. Fifty-one patients (78%) had undergone double lung transplant, 9 patients (14%) had undergone single-lung transplant, and 5 patients (8%) had undergone heart-lung transplant. Median time to CLAD diagnosis was 3 years (interquartile range [IQR], 2-5). Patients had progressed (10% or greater decline in FEV1) on first-line azithromycin. At ECP initiation, 35 patients (54%) were graded BOS stage 3; 21 patients (32%) were BOS stage 2; and 9 patients (14%) were BOS stage 1 or 0p (potential BOS). ECP was administered every 2 weeks for 3 months; subsequent treatments were administered not more than 8 weeks apart to maintain stabilized graft function. Median follow-up was 17 months; 44 patients who continued treatment beyond 3 months received a median of 15 ECP treatments. Eight patients (12%) achieved a 10% or greater improvement in FEV1, considered treatment response; 27 patients (42%) experienced no change in FEV1; and 30 patients (46%) experienced a 10% or greater decline in FEV1, considered progressive disease. Median progression-free survival was 13 months among responders and 4 months among those who did not respond. These data are retrospective and lack a control group.

Jaksch and colleagues reported on a series of 194 patients who developed BOS and received standard treatment and 51 of those received additional ECP. Patients who did not respond to standard immunosuppressive therapy and showed further decline of lung function received EPC when reaching BOS stage greater or equal to 1. Extracorporeal photopheresis was performed on 2 successive days every 2 weeks during the first 3 months and every 4 weeks after until the end of therapy. ECP was stopped after a minimum of 3 months of therapy when lung function decreased significantly. If improvement or stabilization of forced expiratory volume in one second (FEV1) occurred, ECP was continued for a minimum of 6 months. FEV1 values at 3, 6, and 12 months after EPC initiation were used as a surrogate for treatment response. The primary endpoint was change in lung function before and after ECP. Changes in lung function score was compared to patients with BOS who did not receive add on EPC. Eighteen percent of patients receiving ECP experienced an improvement in FEV1 for more than one year after initiation of ECP treatment and 12% showed improvement for only 3 to 6 months. FEV1 stabilized in 31% of patients and declined in 39%. Kaplan-Meier analysis showed a significant difference in responders and non-responders in survival and the need for a transplant. When compared to patients with BOS who did not receive EPC but with similar demographics and prior treatment, the ECP-treated groups had longer survival (p = 0.046) and underwent fewer transplantations: 18 versus 21 (p = 0.04). Time to transplant was also twice as long in the ECP group, 1,839 ± 1,090 days versus 947 ± 861 days. No adverse events were reported as a result of
EPC. While this was not a randomized study, a group was available for comparison with similar demographics, and treatment history.

Lucid and colleagues (2011) published a review of 9 patients treated with ECP between July 2008 and August 2009. Median follow-up was 23 months post-transplant (range: 9-93 months), and the median age was 38 years (range: 21-54 years). The primary indication for ECP was symptomatic progressive BOS, which failed prior therapy. Patients were treated weekly with 2 sessions of pheresis for 3-4 weeks. Treatment then decreased in frequency to every 2 to 3 weeks, with the goal of getting treatment to every 4 weeks. Clinical response was defined as symptomatic improvement, decreased dependency on supplemental oxygen, and improvement in pulmonary function tests (PFTs). Sixty-seven percent (6 of 9) patients responded to ECP after a median of 25 days. No ECP-related complications occurred in this series.

As with prior studies, this report has no control group for comparison.

Morrell et al. published a retrospective case series of all lung transplant recipients treated with ECP for progressive BOS at Barnes-Jewish Hospital-Washington University. Ninety-five percent of the patients had received a bilateral lung transplant and were BOS grade 3. The indication for ECP was progressive decline in lung function that was refractory to standard immunosuppressive therapy. Primary endpoint of the study was the rate of change in lung function before and after the initiation of ECP. Extracorporeal photopheresis was delivered as 2 cycles on days 1, 2, 5, 6, 10, 11, 17, 18, 27, and 28 during the first month (10 treatments); biweekly for the next 2 months (8 treatments); and then monthly for the following 3 months (6 treatments, for a total of 24 treatments. Patients were followed from the time of lung transplantation to death or the end of the study (July 1, 2008). Median follow-up time was 5.4 years (range: 1.0–16.6 years). Sixty patients were followed; at the end of the study, 33 patients were still alive, with 4 deaths occurring early in the study. The majority of deaths were due to progression of respiratory failure, except for 1 death due to sepsis and 1 to graft failure. The mean rate of decline in FEV1 in the 6 months prior to ECP was -116.0 mL per month; after ECP, the mean rate of decline decreased to -28.9 mL per month. The mean difference in the rate of decline was 87.1 mL (95% confidence interval [CI]: 57.3–116.9 mL per month). The rate of decline in lung function was reduced in 44 patients (78.6%), and lung function improved for 14 (25%) of these patients, with an increase in the FEV1 above pretreatment values. Through 12 months of follow-up, the mean improvement in FEV1 was 145.2 mL. Ten of 60 patients experienced adverse events. Eight were hospitalized for catheter-related bacteremia; 1 case resulted in death. All cases resulted from indwelling pheresis catheters. The authors concluded that ECP was associated with a significant reduction in the rate of decline in lung function. This reduction was sustained through 12 months of follow-up. The major limitation of this study is its retrospective nature and the lack of a control group for comparison. A majority of these patients had BOS grade 3, and therefore, may be different than patients with other grades. The statistical analysis was well-done, with robust methods to analyze the available data.

As mentioned earlier, Benden et al (2008) published a single-center study of 24 patients treated with ECP (12 for BOS and 12 for recurrent acute rejection, reviewed in a previous section). ECP was delivered when BOS grade worsened despite standard therapy. At the start of therapy, 5 patients had BOS grade 1; 2 patients had BOS grade 2; and 5 patients had BOS grade 3. Before ECP, the rate of decline in FEV1 was 112 mL/mo compared with 12 mL/mo after ECP (mean difference, 100 mL/mo; range, 28-171). However, ECP did not seem to affect absolute FEV1. Treatment was well-tolerated with no ECP-related adverse
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events reported. Median patient survival was 7.0 years (range, 3.0-13.6); median patient survival post-ECP was 4.9 years (range, 0.5-8.4). However, these results are for all 24 patients (ie, including the 12 patients with BOS).

As noted above, Villanueva and colleagues retrospectively reviewed data on 14 transplant patients (7 bilateral lung, 6 single lung, 1 heart-lung) recipients who received ECP for BOS. All patients were refractory to standard immunosuppressive therapy. Extracorporeal photopheresis was administered every 2 weeks for 2 months, followed by once monthly therapy for the next 2 months, for a total of 6 treatments. Four of eight patients with initial BOS grade of 0 or 1 had improvement in BOS or stabilization of BOS after treatment. Mean survival after ECP was 14 +/- 12 months. The 6 patients with initial BOS grade 2 or higher suffered progression of their BOS after ECP. Mean survival after ECP was 14 +/- 10 months. Four of these patients died of chronic rejection, 1 of lung cancer. The remaining patient survived to retransplantation. Two of the 14 patients developed line-related sepsis, which was cleared with antibiotics and the removal of the vascular catheter.

O'Hagan and colleagues published in 1999, case reports of 6 patients at the Cleveland Clinic who received ECP for BOS refractory to standard immunosuppressive therapy and various other strategies including antithymocyte globulin, methotrexate, monomurine anti-C3 antibody, and tacrolimus. Extracorporeal photopheresis was performed on 2 consecutive days twice a month until stabilization of the FEV1. Treatment was then repeated every 4 to 6 weeks. Four of the 6 patients had temporary stabilization of their airflow obstruction with minimal adverse effects. Grade of BOS was not reported. Case report data suffer from the lack of a control group, which allows for a measurement of the difference in outcomes between two treatments. In this case, that would be the difference in FEV1 between those receiving immunosuppressive therapies alone versus those being treated with immunosuppressive therapy combined with ECP. Larger prospective randomized trials are necessary to examine the comparative effects of ECP for patients with BOS stratified by BOS grade.

Prevention of BOS and/or Rejection
There are no studies addressing the prophylactic effects of ECP for lung transplant recipients.

Liver
The published evidence on the use of ECP in liver recipients is from one group in Italy. Urbani and colleagues have published a series of papers on various potential applications of ECP for liver transplant patients. The first paper is a retrospective review of 5 patients who received liver transplants and ECP for biopsy-proven allograft rejection, in which the indications for ECP were recalcitrant ductopenic rejection with hepatitis C virus recurrence, corticosteroid-resistant acute rejection in 2 patients, severe acute rejection in a major ABO-incompatible liver graft, and severe acute rejection in a patient with a proven corticosteroid allergy. Extracorporeal photopheresis was performed twice a week for 4 weeks, then every 2 weeks for 2 months and once a month, thereafter. Extracorporeal photopheresis was stopped when indicated by biopsy-proven rejection reversal or the absence of clinically evident rejection relapse. Liver function tests improved to baseline in all but 1 patient, and no procedure-related complications were reported. At a median follow-up of 7.9 months, 3 patients were off ECP with normal liver tests and low-level immunosuppressive therapy. Two were receiving continued ECP treatments with full-dose immunosuppressive therapy.
The second paper from 2007 was a nonrandomized comparative study of 36 patients (18 treatment and 18 historic matched controls) who were treated with ECP to delay the introduction of calcineurin inhibitors (CNI) with the goal of preventing toxicity. Patients were included if they were at risk of post-liver transplant renal impairment and neurologic complications, defined as having at least 1 of the following risk factors: a calculated glomerular filtration rate equal to or less than 50 mL/min at transplantation; severe ascites; history of more than one hospitalization for encephalopathy within 1 year of transplant and/or one hospitalization within 1 month of transplantation; or age 65 years or older. Outcome measures were treatment success rate, defined as the ratio of patients with full CNI-sparing or delayed immunosuppression, interval from liver transplant to CNI introduction, safety of ECP, and need for biopsy. Extracorporeal photopheresis was initiated in the first week post-transplant; two different systems (Therakos and PIT) for photopheresis were used, and treatment was given according to a common schedule for the system used. All 18 patients completed the scheduled course and tolerated the ECP. CNI was introduced at a mean number of 8 days for 17 patients, while 1 patient remained CNI-free for 22 months. Acute rejection was higher but not significantly higher in the ECP group versus in controls. One-, 6-, and 12-month survival rates were 94.4, 88.1, and 88.1%, respectively, for ECP recipients versus 94.4, 77.7, and 72.2%, respectively, among controls. The authors concluded that the addition of ECP offers better management of liver transplant patients in the early transplant phase, delayed CNI introduction, and lower CNI-related mortality. This study was not randomized and had a small number of patients.

The third paper (2008) was a report on three fields of interest for ECP as prophylaxis of allograft rejection in liver transplant patients. The three fields include:

- Use of ECP to delay CNI among high-risk liver transplant recipients to avoid toxicity (discussed above),
- Use of ECP for prophylaxis of acute cellular rejection among ABO-incompatible liver transplant recipients where 11 consecutive patients underwent ECP with immunosuppression with no evidence of acute rejection through 568 days of follow-up,
- Use of ECP in hepatitis C virus-positive patients (the use of ECP for the prevention of hepatitis C virus recurrence is beyond the scope of this policy).

Except for the first area, these studies were small and had no comparison group. Randomized, clinical trials are needed for the proper assessment of outcomes.

Renal

Recurrent, Multiple and/or Refractory Rejection

The largest reported group of renal patients to receive ECP was at the Royal Prince Alfred Hospital, Sydney, Australia. In 2009, Jardine et al. published a prospective case series of 10 patients treated with ECP for recurrent and/or refractory rejection after renal transplant at this center. Extracorporeal photopheresis was delivered weekly for 4 weeks, then every 2 weeks. Total treatment range was 2 to 12 treatments for more than 5-20 weeks. Median follow-up time was 66.7 months following transplant and 65.0 months from commencement of ECP. Indication for ECP was acute resistant/recurrent rejection in 9 patients and the need to avoid high-dose corticosteroids in another. Refractory rejection was resolved in all patients through the stabilization of renal function. The authors concluded that ECP may have a role as an adjunct to current therapies in patients with refractory rejection. While this is the largest series of renal
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patients, it is small and there is no comparison group. It also suffers from the fact that renal biopsies were not used to document therapeutic response.

The remainder of the evidence in renal transplant recipients comes from case reports on 32 patients. Twenty-six of these patients had refractory rejection. After ECP, renal function improved in 19 of 26 patients, 3 patients were stable and 4 patients returned to dialysis due to deteriorating function. Reports of long-term outcomes varied. Among the 22 patients who showed initial improvement and or stabilization of renal function, 5 had improved function at 1 year, 1 was stable at 25 months, 5 were stable at 1 year, 7 were rejection-free at 2 to 5 years, and 1 graft was lost. Three patients did not have long-term outcome reports.

Ongoing Clinical Trials

Some currently unpublished trials that might influence this policy are listed in Table 1.

Table 1. Summary of Key Trials: Solid Organ Transplant

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NCT: national clinical trial.

a Final data collection date for primary outcome measure

Summary

Evidence for the use of ECP in cardiac transplant patients relates to 3 indications: acute rejection; recurrent, multiple and/or refractory rejection; and prevention of rejection. For acute rejection, a 1992 randomized trial enrolled 16 heart transplant recipients. ECP in combination with immunosuppressive therapy had similar efficacy compared with immunosuppressive therapy alone, with fewer infections in the ECP group. This study was small, and time from transplantation to study entry varied. For prevention of rejection, 1 randomized trial from 12 clinical sites randomized 33 patients to immunosuppressive therapy plus ECP and 27 patients to immunosuppressive therapy alone. Differences between numbers of acute rejection episodes were statistically significant; however, there was no difference in survival at 6 months. Thus, evidence to date is insufficient to permit conclusions concerning the effect of ECP on net health outcome for the treatment and prevention of acute cardiac rejection. Therefore, ECP is considered investigational for the treatment and prevention of acute rejection in cardiac transplant recipients. Studies with more patients and longer follow-up are needed.

ECP for recurrent, multiple and/or refractory cardiac allograft rejection has been the focus of most of the research on ECP. Although data are from nonrandomized studies, a comparative study of 343 cardiac transplant recipients in which 36 patients received ECP has been completed. The authors showed that at 3 months, ECP was related to a risk reduction of HC rejection or rejection death (risk ratio [RR], 0.29). A reduction in HC rejection or rejection death was observed through 2 years of follow-up. Although results of this trial may be confounded by improvements in immunosuppressive therapy regimens over time, they are...
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consistent with the remainder of the literature for this indication, which indicates a benefit of ECP in patients
with recurrent or refractory cardiac rejection. Thus, the evidence to date, comprising 1 nonrandomized
comparative study, 3 case series, and a case report of 4 patients, provides consistent evidence for a
beneficial effect of ECP for cardiac transplant patients with rejection refractory to standard therapy.
Therefore, ECP is considered medically necessary for the treatment of recurrent, multiple and/or refractory
cardiac rejection.

Evidence on the use of ECP in lung transplant recipients relates to 2 indications: acute rejection and chronic
rejection refractory to corticosteroids/refractory BOS. Data for acute rejection are very limited and do not
permit any conclusions. Patients were subgroups of larger studies who received ECP during periods of
acute rejection. This area needs a prospective, randomized, clinical trial focused specifically on the
treatment of patients in acute rejection.

The bulk of the evidence for ECP in lung transplantation focuses on treatment of refractory BOS. The
primary limitations of these data are that they are nonrandomized and uncontrolled. Further, the evidence is
not entirely consistent, with some studies reporting ECP to be beneficial in those with early refractory BOS
but not in those with grade 2 or higher BOS, which contrasts with a retrospective series of 60 patients who
responded well to ECP (nearly 60% of these patients were BOS grade 3). Prospective, RCTs are
necessary, and analyses should be stratified by BOS grade, as there is some preliminary evidence that
ECP efficacy may vary by BOS grade at the start of therapy.

In liver transplantation, evidence for the use of ECP is limited, and research to date has been generated by
one group in Italy. Although there is 1 comparative (nonrandomized) study, it involved only 18 cases and 18
historical controls. There is a need for RCTs. The focus in liver transplantation has been on prevention of
rejection with ECP. This question lends itself well to a RCT comparing immunosuppressive therapy alone
with immunosuppressive therapy with ECP. The evidence to date, which consists of small case series and 1
comparative study, is insufficient to permit conclusions concerning the effect of ECP on net health outcome
for liver transplant patients. Therefore, ECP is considered investigational in liver transplant patients for any
indication.

For renal transplant recipients, evidence for the use of ECP is sparse. A total of 42 ECP-treated patients
have been reported in the literature. Studies consistently report evidence of benefit from ECP for those with
refractory rejection. However, there are no comparative studies and current numbers are too small to permit
conclusions. A prospective, randomized trial, with histologic confirmation of treatment response is needed.
This trial would randomize patients to immunosuppressive therapy or immunosuppressive therapy with ECP
to address the question of whether there is an additional benefit from ECP for patients with refractory
rejection after renal transplantation. Evidence to date, which comprises small case series, is insufficient to
permit conclusions concerning the effect of ECP on net health outcome for renal transplant patients.
Therefore, ECP is considered investigational in renal transplant patients for any indication.

Graft-versus-Host Disease
Extracorporeal photopheresis for the treatment of acute and chronic GVHD was initially addressed by a
2001 TEC Assessment that offered the following observations and conclusions: For acute GVHD or chronic
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GVHD in previously untreated patients or in those responding to conventional therapy, no studies met selection criteria and reported results of ECP, alone or in combination with other therapies. Therefore, photopheresis for these indications failed to meet TEC criteria. Studies focusing on patients with chronic GVHD unresponsive to other therapies reported resolution or marked improvement of lesions in approximately 50% of patients. Finally, studies of patients with acute GVHD also reported a successful outcome in 67–84% of patients with grade III disease, but patients with grade IV disease rarely responded.

Treatment of Graft-versus-Host Disease in Pediatrics

The most recent and largest series was a retrospective review of 50 pediatric patients (age < 18 years) with acute or chronic GVHD after an allogeneic stem-cell transplant unresponsive to 1-week steroid treatment. These patients were given ECP for a minimum of 10 treatments. Extracorporeal photopheresis was administered 2-3 procedures per week on alternating days until clinical improvement. Treatment was then reduced to 2 procedures per week for 2 weeks, then 2 procedures every other week for 3 weeks, ending with 2 procedures per month until maximum response as clinically indicated. Extracorporeal photopheresis was discontinued if no improvement was seen after 4 weeks. Eighty-three percent (39/47) of patients had improvement in cutaneous acute GVHD, and 87.5% (7/8) saw improvement in the oral mucosa. Among patients with chronic GVHD, the greatest improvement was seen in the liver, with 100% (4/4) seeing improvement, followed by 95.6% (22/23) showing improvement of skin lesions.

The literature also includes, but is not limited to, two small studies that focused on photopheresis for treatment of GVHD in children and one larger retrospective case series. The case series published in 2007 reported results of ECP for steroid-resistant GVHD in pediatric (aged 6–18 years) patients who had undergone hematopoietic stem-cell transplantation to treat a variety of cancers. Patients had acute GVHD (aGVHD, n = 15, stages II-IV) or chronic GVHD (cGVHD, n = 10, 7 deemed extensive) that did not respond to at least 7 days of methylprednisolone therapy. Patients received ECP on 2 consecutive days at weekly intervals for the first month, every 2 weeks during the second and third months, and then at monthly intervals for a further 3 months. Extracorporeal photopheresis was progressively tapered and discontinued based on individual patient response. Response to ECP was assessed 3 months after ECP ended or after 6 months if the ECP protocol was prolonged. Among patients with aGVHD, a complete response (CR) was observed in 7 of 7 (100%) with grade II and 2 of 4 (50%) with grade III illness, whereas none with grade IV responded to ECP. In the group with cGVHD, 3 of 3 (100%) with limited disease had CR, compared to 1 of 7 (14%) with extensive disease who had CR; 5 of 7 (71%) of patients with extensive cGVHD had no response to ECP. Adverse effects of ECP were generally mild in all cases. These results are similar to those summarized in the 2001 TEC Assessment cited previously and thus do not alter the current policy statements.

In the two smaller studies, 1 study, 8 children (aged 5–15 years) with refractory extensive chronic GVHD were treated with ECP and either oral 8-MOP or infusion of an 8-MOP solution into the pheresed lymphocytes. Cutaneous status reportedly improved in 7 patients. Five patients stopped treatment, and 3 others decreased doses of immunosuppressive therapy. In addition, gut involvement resolved in all patients, and liver involvement resolved in 4 of 6 patients. Two years following discontinuation of photopheresis, 5 patients remained in remission without immunosuppressive therapy. Salvaneschi and colleagues reported on photopheresis results in refractory GVHD in 9 acute pediatric cases and in 14
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chronic pediatric cases (aged 5.4–11.2 years). In the acute GVHD cases, 7 of 9 experienced either partial response (PR) or CR, while in the chronic GVHD patients, 9 of 14 experienced either partial or complete remission. These findings are also consistent with the current policy statements.

In 2014, the Cochrane Collaboration childhood cancer group published 2 systematic reviews on aGVHD and cGVHD in pediatric patients. Literature searches were performed in September 2012, and no RCTs were found. The authors cited the need for RCTs but stated that “performing RCTs in this patient population will be challenging because of the limited number of patients, the variable disease presentation, and the lack of well-defined response criteria.” International collaboration and establishment of patient registries was encouraged.

**Treatment of Graft-versus-Host Disease in Adults**

**Chronic GVHD**

In addition to the 2001 TEC Assessment referenced above, several additional publications report on the use of ECP for the treatment of GVHD. In 2006, the Ontario Health Technology Advisory Committee (OHTAC) published results of a systematic review of ECP for the treatment of refractory chronic GVHD. In summary, OHTAC reported that there is low-quality evidence that ECP improves response rates and survival in patients with chronic GVHD who are unresponsive to other forms of therapy. Limitations in the literature related to ECP for the treatment of refractory GVHD mostly pertained to the quality, size, and heterogeneity in treatment regimens and diagnostic criteria of available clinical studies. The committee did, however, recommend a 2-year duration field evaluation of ECP for chronic GVHD, using standardized inclusion criteria and definitions to measure disease outcomes including response rates, quality of life, and morbidity. As of January 2014, this evaluation is not listed on the OHTAC website.

Malik et al (2014) published a systematic review of ECP for steroid-refractory cGVHD. Literature was searched through July 2012 and 18 studies were included (4 prospective, including 1 RCT, and 14 retrospective; N=595). In meta-analyses, overall and CR rates were 64% and 29%, respectively. Pooled RR was highest for cutaneous disease (74%) and lowest for lung disease (48%). Statistical heterogeneity was high for all of these results ($I^2$>60%).

Foss and colleagues reported results of a prospective (non-randomized) study of ECP in 25 patients who had extensive corticosteroid-refractory or corticosteroid-resistant chronic GVHD secondary to allogeneic stem-cell transplantation. Extracorporeal photopheresis was administered for 2 consecutive days every 2 weeks in 17 patients and once weekly in 8 until best response or stable disease was achieved. With a 9-month median duration (range 3–24 months) of ECP, 20 patients had improvement in cutaneous GVHD, and 6 had healing of oral ulcerations. Extracorporeal photopheresis allowed cessation or reduction of immunosuppressive medication treatment in 80% of patients. Overall, improvement was reported in 71% of cases with skin and/or visceral GVHD and 61% of those deemed to be high-risk patients.

In 2014, Dignan et al reported on a series of 38 consecutive adults who received ECP for cGVHD. median patient age was 47 years (range, 18-73). Patients had steroid-refractory or steroid-dependent disease or were intolerant of corticosteroids. Thirty-six patients (95%) were receiving immunosuppressive therapy. ECP was administered on 2 consecutive days every 2 weeks until PR (defined as minimum 50%
improvement from baseline in 1 organ and no evidence of GVHD progression in other organs) was achieved and was then reduced to monthly treatments. Median time from transplant to first ECP was 1.7 years (range, 0.25-7.25). Response was assessed after 6 months. Nineteen patients (50%) had a CR (n=2; defined as complete resolution of all signs and symptoms of GVHD) or PR (n=17); all 19 had completed 6 months of ECP. Of 25 patients receiving immunosuppressive therapy who completed 6 months of ECP, 20 (80%) reduced immunosuppressive dose; 5 patients discontinued steroids, and 8 patients had a 50% or greater reduction in steroid dose. Mean improvements in validated quality-of-life (QOL) measures (Lee chronic GVHD symptom scale and dermatology QOL index) were clinically and statistically significant in 17 (94%) of 18 patients who completed the questionnaires at 6 months. Five patients developed indwelling catheter-related infections, 1 patient had a catheter-related thrombosis, and 1 patient had an increase in red cell transfusion requirements, which was considered due to ECP alone.

**Acute GVHD**

In 2015, Zhang et al in China reported a systematic review of prospective studies of ECP for aGVHD. Literature was searched through September 2014, and 7 cohort studies were included (N=121). In meta-analyses, pooled overall and CR rates were both 71%. Statistical heterogeneity was considered not high for both results ($I^2<50\%$). Response rate was highest for cutaneous disease (86%), although a funnel plot indicated the presence of publication bias.

Greinix et al (2006) reported findings from a Phase II (nonrandomized) study to evaluate the efficacy of intensified ECP as second-line therapy in 59 patients with post-stem cell transplant acute (grades II-IV), steroid-refractory GVHD. Extracorporeal photopheresis was initially administered on 2 consecutive days (1 cycle) at 1- to 2-week intervals until improvement was noted and thereafter every 2 to 4 weeks until maximal response. At the start of ECP, all patients had been receiving immunosuppressive therapy with prednisone and cyclosporine A. Complete resolution of GVHD was documented in 82% of cases with cutaneous manifestations, 61% with hepatic involvement, and 61% with gut involvement. A CR was noted in 87% and 62% of patients with exclusively skin or skin and liver involvement, respectively; only 25% with GVHD of skin, liver and gut involvement and 40% with skin and gut involvement obtained a CR of GVHD with ECP therapy. The probability of survival was 59% among patients with CR to ECP, compared to 11% of those who did not respond completely. While these results suggest ECP may be beneficial in the treatment of acute GVHD, the small size, few study details in the report, and lack of a standard treatment comparator group limit inferences as to the clinical efficacy of ECP for acute GVHD.

In 2008, Perfetti and colleagues reported on a retrospective review of 23 patients with corticosteroid-refractory acute GVHD, 10 grade II, 7 grade III, and 6 grade IV. Median duration of ECP was 7 months (1–33 months) and median number of cycles per patient was 10. Complete responses were seen in 70%, 42%, and 0% of patients with GVHD grades II, III, and IV, respectively. Eleven patients (48%) survived and 12 died: 10 of GVHD and 2 of relapse of leukemia. Patients treated within 35 days from onset of GVHD had a higher but not statistically significant different response (83 vs. 47%, respectively; $p = 0.1$). While these findings suggest that ECP may provide benefit for patients with refractory acute GVHD, they are limited by the small sample size and non-comparative nature of the study.
Shaughnessy et al (2010) studied ECP to prevent aGVHD in patients undergoing standard myeloablative conditioning and allogeneic transplant. ECP was administered before a standard conditioning regimen. Results were compared with historical controls from the Center for International Blood and Marrow Transplant Research database. Multivariate analysis indicated a lower incidence of grade 2 to 4 acute GVHD among patients who received ECP. Adjusted overall survival (OS) at 1 year was 83% in the ECP group and 67% among historical controls (risk ratio, 0.44; 95% CI, 0.24 to 0.80). Additional prospective RCTs are necessary to confirm these findings.

Jagasia et al (2013) reported an international, retrospective comparative analysis of nonconcurrent cohorts who received ECP (n=57) or anticytokine therapy (inolimomab or etanercept; n=41) for grade 2 or higher steroid-refractory aGVHD. ECP was initiated at 2 to 3 treatments weekly or biweekly until maximal response and then discontinued (European sites) or tapered (U.S. sites). More patients in the ECP group than in the anticytokine group experienced overall response (CR plus PR; 66% vs 32%, p=0.001) and CR (54% vs 20%, p=0.001). Two-year OS was 59% in the ECP group and 12% in the anticytokine group (p value not reported).

Rubegni et al (2013) reported on a cohort of 9 patients with grade 2 to 3 steroid-refractory aGVHD at a single institution in Italy. ECP was administered on 2 consecutive days weekly until improvement and then every 2 weeks; treatment was then tapered as tolerated. At 3 months, mean dose of methylprednisolone decreased from 2.22 mg/kg to 0.27 mg/kg, and mean dose of cyclosporine decreased from 2.46 mg/kg to 0.77 mg/kg. Six patients (67%) showed a complete skin response. Five (83%) of 6 patients with liver and gastrointestinal tract involvement had CRs. All patients developed cGVHD, 7 (78%) while still receiving ECP.

**aGVHD and cGVHD**

In 2014, Abu-Dalle et al published a systematic review of prospective studies in patients with steroid-refractory acute or chronic GVHD. Literature was searched through February 2013, and 1 RCT in patients with cGVHD and 8 cohort studies in patients with aGVHD and/or cGVHD were identified (N=323). In meta-analyses, overall response rates (ORR) for aGVHD and cGVHD were 69% and 64%, respectively. In both aGVHD and cGVHD, ORR was highest in cutaneous disease (84% and 71%, respectively) followed by gastrointestinal disease (65% and 62%, respectively). Rates of immunosuppression discontinuation were 55% and 23% for aGVHD and cGVHD, respectively. Statistical heterogeneity for most meta-analyses was high ($I^2$>60%).

Hautmann et al (2013) reported on a cohort of 62 patients with aGVHD (n=30) or cGVHD (n=32) at a single institution in Germany. For aGVHD, ECP was administered 2 or 3 times weekly on consecutive days until clinical improvement, then 2 treatments on consecutive days biweekly, reducing to monthly, if tolerated. At 3 months, 15 patients (50%) achieved CR or PR (9 [30%] complete). Ten (83%) of 12 patients who continued ECP beyond 3 months and had data available decreased steroid dose by 50% or more. For cGVHD, ECP was administered on 2 consecutive days weekly until improvement, then biweekly for 3 to 4 weeks, and then monthly. At 3 months, 14 patients (44%) achieved CR or PR (2 [6%] complete). Five (29%) of 17 patients who continued ECP beyond 3 months had data available and were taking steroids at baseline, decreased steroid dose by 50% or more.
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Ussowicz et al (2013) reported on 21 patients with steroid-refractory or steroid-dependent, grade 3 or 4 acute (n=8) or extensive chronic (n=13) GVHD in Poland. For aGVHD, ECP was administered on 2 consecutive days weekly for up to 4 weeks. Although clinical response was noted in 3 patients (37.5%), there were no long-term (more than 18 months after ECP) survivors. For cGVHD, ECP was administered on 2 consecutive days every 2 weeks for 14 weeks and then monthly for up to 8 weeks. Four-year OS was 67.7%.

Ongoing Clinical Trials

Some currently unpublished trials that might influence this policy are listed in Table 2.

Table 2. Summary of Key Trials: Graft Versus Host Disease

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</table>

NCT: national clinical trial.

Clinical Input Received 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, academic medical centers, or Blue Distinction Centers for Transplant unless otherwise noted.

In response to requests, input was received through 2 academic medical centers and 5 Blue Distinction Centers for Transplant when this policy was under review in 2014. Respondents agreed unanimously that ECP should not be medically necessary in previously untreated aGVHD but should be medically necessary in aGVHD that is refractory to medical therapy.
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Section Summary
Evidence for the use of ECP for the treatment of GVHD relates to both aGVHD and cGVHD in pediatric and adult populations. The published literature lacks randomized trials. Evidence comprises retrospective reviews and nonrandomized comparisons. These data consistently show improvement in GVHD that is unresponsive to standard therapy and are consistent with conclusions from the 2001 TEC Assessment. Additionally, there is a lack of other treatment options for these patients; adverse effects of ECP are minimal; and, if there is a response to ECP, patients may be able to reduce or discontinue treatment with corticosteroids and other immunosuppressive agents. Clinical input unanimously supported the use of ECP in patients with refractory aGVHD. Therefore, treatment of refractory aGVHD or cGVHD with ECP is considered medically necessary.

For patients with untreated disease or those who are showing improvement on standard therapy, there is no data to support the use of ECP. Therefore, ECP is considered investigational in these settings.

Autoimmune Disease
Extracorporeal photopheresis for the treatment of autoimmune diseases was initially addressed by a 2001 TEC Assessment, which offered the following observations and conclusions. A variety of autoimmune diseases were considered, including systemic sclerosis, pemphigoid, systemic lupus erythematosus, multiple sclerosis, psoriatic arthritis, rheumatoid arthritis, and type I diabetes. For all of these indications, the available evidence was insufficient to permit conclusions on outcomes. At the time, photopheresis had been most thoroughly studied as a treatment of scleroderma. However, the data on this indication include 1 single-blind RCT and 3 small, uncontrolled series. While the randomized study reported positive outcomes in terms of skin manifestations, a number of methodologic flaws have been discussed in the literature, including inadequate treatment duration and follow-up, excessive dropouts, a mid-study change of primary outcome, and inadequate washout of prior penicillamine therapy. Results reported from other small case series regarding systemic sclerosis conflict with each other and do not resolve the difficulties in interpreting the randomized trial.

Type 1 Diabetes Mellitus
A subsequent clinical trial on diabetes was published by Ludvigsson et al in 2001. This was a randomized double-blind controlled trial on photopheresis in 49 children with newly diagnosed type 1 diabetes. Forty children (age, 10-18 years) completed the study and were followed for 3 years. All patients received standard treatment with insulin therapy and diet, exercise, and self-management education. Of these patients, 19 received active photopheresis treatment with oral 8-MOP, and 21 received placebo tablets and sham pheresis. Hemoglobin A1C did not differ statistically between groups.

Multiple Sclerosis
Cavaletti et al (2007) published a small case series of 5 patients with immunorefractory relapsing-remitting multiple sclerosis who received ECP. ECP appeared safe and tolerable in these patients, with some evidence for a reduction in the relapse rate and symptom stabilization. However, data are insufficient to alter the policy statement for this use of ECP.
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Bullous Disorders
In 2010, Sanli and colleagues published a retrospective report on 11 patients with drug-resistant autoimmune bullous diseases. Extracorporeal photopheresis was performed between January 2005 and January 2010. Eight of these patients had pemphigus vulgaris (PV), while the others had epidermolysis bullosa acquisita (EBA). Patients were treated on 2 consecutive days at 4-week intervals. Among the patients with PV, all experienced complete remission after 2-6 cycles, except one. Two patients with EBA had complete remission, while one patient had partial remission. Corticosteroids were reduced in all patients with PV. Decrease in the frequency of ECP resulted in progression of lesions for 3 patients with PV and in 2 of the patients with EBA. No adverse effects were observed. Randomized controlled trials are necessary to adequately assess the efficacy of ECP for patients with drug-resistant autoimmune bullous diseases.

Scleroderma (Systemic Sclerosis)
In addition to the RCT previously discussed, a 2012 cohort study by Papp et al enrolled 16 patients from a single institution in Hungary who had diffuse cutaneous systemic sclerosis. ECP was administered on 2 consecutive days every 6 weeks for 6 cycles. At the end of the treatment period, statistically significant reductions from baseline dermal thickness (by echography) were observed at 4 extensor surfaces (upper arm, forearm, hand, finger). Lung diffusing capacity did not decrease more than 5% in any of 9 patients with pulmonary fibrosis at baseline.

Severe Atopic Dermatitis
Some patients with atopic dermatitis do not respond to standard treatments and require immunosuppression with traditional (eg, systemic corticosteroids, azathioprine, cyclosporine, mycophenolate mofetil, methotrexate) or biologic (eg, alefacept, rituximab, intravenous immunoglobulin, infliximab, omalizumab) agents for chronic disease. In 2013, Rubegni et al reported on 7 patients and summarized previous case series and case reports of patients with varying disease severity who were treated with ECP. Of 81 total patients, 69 (85%) were considered responders to ECP. Wolf et al subsequently published a case series of 10 adults with severe, refractory atopic dermatitis of at least 1-year duration. ECP was administered for 2 consecutive days biweekly for 12 weeks and then monthly for 2 months. Only concomitant topical treatments and antihistamine were allowed. Mean (SD) baseline SCORAD (Scoring of Atopic Dermatitis) was 64.8 (18.9) on a 0- to 103-point scale, indicating moderate to severe disease. At week 20, mean (SD) SCORAD was 54.5 (22.8), a statistically significant improvement (p=0.015) of uncertain clinical significance. Improvements in QOL measures did not reach statistical significance. This evidence is insufficient to support the use of ECP in patients with severe atopic dermatitis.

Crohn Disease
Patients with steroid-dependent Crohn disease may respond to double immunosuppression with azathioprine and infliximab, but these treatments are associated with significant adverse events, particularly with long-term use. Reinisch et al (2013) assessed the steroid-sparing effect of ECP in 31 patients with steroid-dependent Crohn disease in clinical remission (Crohn Disease Activity Index [CDAI] <150). Other immunosuppressive treatments were tapered and discontinued before ECP initiation and steroid tapering. ECP was administered on 2 consecutive days every 2 weeks for 24 weeks. Steroids were tapered as tolerated during this 24-week period. Nineteen patients (61%) completed 24 weeks of treatment; 7 patients...
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(23%) achieved steroid-free remission at week 24 (the primary end point), and 20 patients (65%) maintained remission with a 50% or greater reduction in steroid dose from baseline. Three patients (10%) maintained steroid-free remission after 48 weeks of ECP (frequency decreased to monthly after week 24), and 3 other patients who discontinued steroids experienced mild disease (CDAI<220) at 48 weeks of ECP. One catheter-related complication was reported. This evidence is insufficient to support the use of ECP in patients with steroid-dependent Crohn disease.

Ongoing and Unpublished Clinical Trials
Some currently unpublished trials that might influence this policy are listed in Table 3.

Table 3. Summary of Key Trials: Autoimmune Disorders

<table>
<thead>
<tr>
<th>NCT No.</th>
<th>Trial Name</th>
<th>Planned Enrollment</th>
<th>Completion Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ongoing</td>
<td>Open-Label Study to Evaluate the Efficacy of ECP in Secondary Progressive Multiple Sclerosis</td>
<td>66</td>
<td>Oct 2017</td>
</tr>
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</table>

NCT: national clinical trial.

Summary
Evidence for the use of ECP for the treatment of autoimmune diseases including multiple sclerosis and cutaneous or visceral manifestations of autoimmune diseases, including but not limited to scleroderma, systemic lupus erythematosus, rheumatoid arthritis, pemphigus, psoriasis, autoimmune bullous disorders, severe atopic dermatitis, Crohn disease, and diabetes, is sparse and insufficient to permit conclusions. There are randomized trials for 2 indications: scleroderma and type 1 diabetes. Methodologic flaws in the scleroderma trial limit applicability of the data. In the type 1 diabetes trial, no difference in hemoglobin A1C was observed between those treated with and without ECP. Therefore, treatment of autoimmune diseases with ECP is considered investigational.

Cutaneous T-Cell Lymphoma
Stage III/IV Mycosis Fungoides and Sezary Syndrome
The initial report on the use of ECP as therapy for CTCL was published by Edelson et al in 1987. Twenty-seven (73%) of 37 patients with otherwise resistant CTCL responded, with a mean 64% decrease in cutaneous involvement after a mean (SD) of 22 weeks. Responders included 8 (80%) of 10 patients with lymph node involvement, 24 (83%) of 29 with exfoliative erythroderma, and 20 (71%) of 28 whose disease was resistant to standard chemotherapy. Adverse effects of standard chemotherapy, such as bone marrow suppression, gastrointestinal erosions, and hair loss, did not occur. In 2012, Knobler et al reanalyzed these data using current response criteria and reported no change in overall response rate. Response was defined as 90% or greater (near CR) or 50% or greater (PR) improvement in skin score for 4 weeks; in the original study, response was defined as 25% or greater improvement for 4 weeks. With 7 years of follow-up, median OS was 9 years from diagnosis and 7 years from the start of ECP. (Mean age at study entry was 57 years [range, 24-80]). These results showed that ECP is safe and effective in advanced, resistant CTCL.

Subsequent results from numerous small, nonrandomized studies generally have been consistent with the initial conclusion that ECP treatment can produce clinical improvement and may prolong survival in a
substantial proportion of patients with advanced stage CTCL. Together, these data provide the basis for several evidence-based guideline or consensus statements on the use of ECP in CTCL, as well as the position of the NCI. NCI consistently recommends ECP as first-line treatment for patients with stage III/IV CTCL.

In 2006, OHTAC published results of a systematic review of ECP for the treatment of erythrodermic CTCL. In summary, OHTAC reported that there is low-quality evidence that ECP improves response rates and survival in patients with CTCL who are unresponsive to other forms of therapy. Limitations in the literature related to ECP for the treatment of refractory erythrodermic CTCL mostly pertained to the quality, size, and heterogeneity in treatment regimens and diagnostic criteria of available clinical studies. The committee did, however, recommend a 2-year duration field evaluation of ECP for refractory erythrodermic CTCL, using standardized inclusion criteria and definitions to measure disease outcomes including response rates, quality of life, and morbidity. As of April 2014, this evaluation is not listed on the OHTAC website.

**Early Stage (I/II) CTCL**

Between 1987 and 2007, data were reported from at least 16 studies including 124 patients with CTCL in early stages IA, IB, or I II who were treated with ECP alone (n = 79) or in combination with other agents (n = 45) including retinoids and interferon-alfa. Many of these patients were refractory to numerous other therapies, including topical corticosteroids, interferon alfa, or whole-skin irradiation. Response rates (partial plus complete) in these studies ranged from 33% to 88% with monotherapy and 50% to 60% with ECP and adjuvant therapies. While these findings suggest ECP may provide benefit in early-stage CTCL, none of the studies was randomized or comparative. Furthermore, many of the studies preceded universal acceptance of standardized elements of classification and diagnosis of CTCL, such as those proposed by the WHO-EORTC. Thus, the actual disease spectrum and burden represented in the available database likely vary between studies, and this complicates conclusions about the efficacy of ECP in this setting. Nonetheless, given the unfavorable prognosis for patients with early-stage CTLC that progresses while receiving nonsystemic therapies, the relative lack of adverse events with ECP compared to other systemic treatments, and the good response rates often associated with ECP, ECP may provide outcome benefit as a technique for the treatment of patients with refractory or progressive early-stage CTCL. By contrast, because early-stage CTCL typically responds to less-invasive, topical therapies, patients whose disease remains quiescent under such treatments usually experience a near-normal life expectancy.

**Ongoing Clinical Trials**

Some currently unpublished trials that might influence this policy are listed in Table 4.

**Table 4. Summary of Key Trials: T-Cell Lymphoma**

<table>
<thead>
<tr>
<th>NCT No.</th>
<th>Trial Name</th>
<th>Planned Enrollment</th>
<th>Completion Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ongoing</td>
<td>Outcomes of Cutaneous T-Cell Lymphoma and Chronic Graft-Versus-Host Disease in Patients Treated with Extracorporeal Photopheresis</td>
<td>100</td>
<td>Oct 2050</td>
</tr>
</tbody>
</table>

NCT: national clinical trial.
Summary
The evidence from small case series has shown a response to ECP in patients with advanced stage CTCL, as well as prolongation of survival in a proportion of patients. Therefore, in this policy, ECP may be considered medically necessary as a technique for the treatment of patients with stages III/IV CTCL.

Given the unfavorable prognosis for patients with early-stage CTLC that progresses while receiving nonsystemic therapies, the relative lack of adverse events with ECP compared to other systemic treatments, and the good response rates often associated with ECP, ECP may be considered medically necessary as a technique for the treatment of patients with refractory or progressive early-stage CTCL.

By contrast, when early-stage CTCL does respond to less-invasive, topical therapies, patients whose disease remains quiescent under such treatments usually experience a near-normal life expectancy. As a consequence ECP is considered investigational as a technique for the treatment of patients with stage I/II CTCL that is either previously untreated or is responding to established therapies.

**Non-cutaneous T-Cell Lymphoma/Leukemia**
Garben et al (2012) used ECP to treat 12 patients with refractory/relapsed disease between 1997 and 2005. Based on the observation that ultraviolet-A (UVA) irradiation-induced apoptosis of the malignant T-cell clone may be a mechanism of action of ECP in CTCL, patients were chosen for therapy based on a peripheral clone detected by flow cytometry. One patient had T lymphoblastic lymphoma; 6 had PTCL (2 with angioimmunoblastic type, 4 with PTCL-NOS [not otherwise specified]); and 5 had large granular lymphocytic leukemia (LGL). At the time of ECP, median age was 49 years (range, 37-82). All patients had failed at least 1 line of therapy. Patients were treated according to the Vilbert-Lourmat procedure. Six courses were given over 3 weeks, followed by 1 course per week for 10 weeks. If at least a PR was observed, treatment continued with 1 course per month until progression or CR with disappearance of the peripheral clone. Response was evaluated after 6 induction courses, then after 10 courses, and then every 3 months until relapse. Of the 12 patients, 6 were in PR after induction (4 PTCL, 2 LGL), and 6 never responded. Of the 6 showing PR after induction, 4 reached CR at 10 courses (2 PTCL, 2 LGL), and 2 patients (with PTCL) had a sustained PR. Although these findings suggest that ECP may provide benefit for patients with noncutaneous T-cell lymphomas and LGL, studies with larger samples are necessary to determine the role of ECP in the treatment of these diseases.

Summary
Data from one small case series showed at least a PR to ECP in some patients with refractory non-cutaneous T-cell malignancies. More data from larger studies are needed to determine the role of this type of therapy in the treatment of these diseases.

**Summary of Evidence**
**Organ Rejection After Solid Organ Transplant**
*Heart*
Evidence for the use of ECP in cardiac transplant recipients relates to 3 indications: acute rejection; recurrent, multiple and/or refractory rejection; and prevention of rejection. For acute rejection and for prevention of rejection, 2 small randomized trials provide insufficient evidence to permit conclusions
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concerning the effect of ECP on net health outcome. Therefore, ECP is considered investigational for the treatment and prevention of acute rejection in cardiac transplant recipients. Studies with more patients and longer follow-up are needed. For recurrent, multiple and/or refractory cardiac allograft rejection, evidence to date provides consistent evidence for a beneficial effect of ECP for cardiac transplant patients with rejection refractory to standard therapy. Therefore, ECP is considered medically necessary for the treatment of recurrent, multiple and/or refractory cardiac rejection.

Lung
Evidence for the use of ECP in lung transplant recipients relates to 2 indications: acute rejection and chronic rejection refractory to corticosteroids/refractory BOS. For acute rejection, data are very limited and do not permit any conclusions. This area needs a prospective, randomized, clinical trial focused specifically on the treatment of patients with acute rejection. For treatment of refractory BOS, data are nonrandomized and uncontrolled and show inconsistent results across BOS grades. Prospective, RCTs are necessary with analyses stratified by BOS grade. Therefore, ECP is considered investigational when used in lung transplantation.

Liver
In liver transplantation, evidence to date has focused on prevention of rejection with ECP. This evidence is insufficient to permit conclusions concerning the effect of ECP on net health outcome. There is a need for RCTs comparing immunosuppressive therapy alone to immunosuppressive therapy with ECP. Therefore, ECP is considered investigational in liver transplant patients for any indication.

Kidney
For renal transplant recipients, evidence comprises small case series in patients with refractory rejection. This evidence is insufficient to permit conclusions concerning the effect of ECP on net health outcome. RCTs comparing immunosuppressive therapy with immunosuppressive therapy with ECP and examining histologic confirmation of treatment response are needed. Therefore, ECP is considered investigational in renal transplant patients for any indication.

Graft-Versus-Host Disease
Evidence for the use of ECP for the treatment of GVHD relates to both acute GVHD and chronic GVHD in pediatric and adult populations. Evidence comprises retrospective reviews and nonrandomized comparisons and consistently shows improvement in GVHD that is unresponsive to standard therapy. Additionally, there is a lack of other treatment options for these patients; adverse effects of ECP are minimal; and, if there is a response to ECP, patients may be able to reduce or discontinue treatment with corticosteroids and other immunosuppressive agents. Clinical input unanimously supported the use of ECP in patients with refractory aGVHD. Therefore, treatment of refractory aGVHD or cGVHD with ECP is considered medically necessary.

For patients with untreated disease or those who are showing improvement on standard therapy, there is no data to support the use of ECP. Therefore, ECP is considered investigational in these settings.
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Autoimmune Disease
Evidence for the use of ECP for the treatment of autoimmune diseases including multiple sclerosis and cutaneous or visceral manifestations of autoimmune diseases, including but not limited to scleroderma, systemic lupus erythematosus, rheumatoid arthritis, pemphigus, psoriasis, autoimmune bullous disorders, severe atopic dermatitis, Crohn disease, and diabetes, is sparse and insufficient to permit conclusions. Therefore, treatment of autoimmune diseases with ECP is considered investigational.

T-Cell Lymphoma
Cutaneous T-Cell Lymphoma
Evidence from small case series has shown a response to ECP in patients with advanced stage CTCL, as well as prolongation of survival in a proportion of patients. Therefore, ECP may be considered medically necessary as a technique for the treatment of patients with stages III/IV CTCL.

Given the unfavorable prognosis for patients with early stage CTCL that progresses on nonsystemic therapies, the relative lack of adverse events with ECP compared with other systemic treatments, and the good response rates often observed with ECP, ECP may be considered medically necessary as a technique for the treatment of patients with refractory or progressive early stage CTCL.

In contrast, when early stage CTCL does respond to less-invasive, topical therapies, patients whose disease remains quiescent under such treatments usually experience near-normal life expectancy. As a consequence, ECP is considered investigational as a technique for the treatment of patients with stage I/II CTCL that is either previously untreated or is responding to established therapies.

Non-CTCL/Leukemia
Data from 1 small case series showed at least a partial response to extracorporeal photopheresis in some patients with refractory noncutaneous T-cell malignancies. More data from larger studies are needed to determine the role of ECP in the treatment of these diseases.

References
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Policy History
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Current Effective Date: 03/15/2017
05/14/2002 Medical Director review
05/16/2002 Medical Policy Committee review
06/05/2002 Managed Care Advisory Council approval
06/24/2002 Format revision. No substance change to policy
06/01/2004 Medical Director review
06/15/2004 Medical Policy Committee review. Format revision. No substance change to policy
06/28/2004 Managed Care Advisory Council approval
07/12/2006 Medical Director review
07/19/2006 Medical Policy Committee review. Format revision. No change to policy guidelines.
11/07/2007 Medical Director review
11/15/2007 Medical Policy Committee approval. No change to coverage eligibility.
11/05/2008 Medical Director review
11/18/2008 Medical Policy Committee approval. No change to coverage eligibility.
12/04/2009 Medical Policy Committee approval.
12/01/2010 Medical Policy Committee approval.
12/15/2010 Medical Policy Implementation Committee approval. No change to coverage.
12/08/2011 Medical Policy Committee review
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Lymphoma”. Added coverage statement for extracorporeal photopheresis to treat cardiac allograft rejection, including acute rejection, that is either recurrent or that is refractory to standard immunosuppressive drug treatment. Extracorporeal photopheresis in all other situations related to treatment or prevention of rejection in solid-organ transplantation added as investigational. Autoimmune bullous disorders added as investigational. Updated coverage guidelines, Background/Overview, Rationale, and References.

12/06/2012 Medical Policy Committee review
12/19/2012 Medical Policy Implementation Committee approval. Coverage eligibility unchanged.
12/12/2013 Medical Policy Committee review
12/18/2013 Medical Policy Implementation Committee approval. Title changed from “Extracorporeal Photopheresis after Solid-Organ Transplant and for Graft-versus-Host Disease, Autoimmune Disease, and Cutaneous T-Cell Lymphoma” to “Extracorporeal Photopheresis”. Statement added that extracorporeal photopheresis is investigational for any other indications.

03/05/2015 Medical Policy Committee review
03/20/2015 Medical Policy Implementation Committee approval. Coverage eligibility updated, added coverage of acute GVHD. Rationale and references updated.
08/03/2015 Coding update: ICD10 Diagnosis code section added; ICD9 Procedure code section removed.
03/03/2016 Medical Policy Committee review
03/16/2016 Medical Policy Implementation Committee approval. Coverage eligibility unchanged.
10/01/2016 Coding update
01/01/2017 Coding update: Removing ICD-9 Diagnosis Codes
03/02/2017 Medical Policy Committee review
03/15/2017 Medical Policy Implementation Committee approval. Coverage eligibility unchanged.

Next Scheduled Review Date: 3/2018

Coding
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<th>Code Type</th>
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**HCPCS** | **No codes**
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A00.0 | C84.00-C84.09  
D89.82-D89.89 | E06.3  
E10.610 | E10.641  
E10.8-E10.9 | E11.00-E11.01  
E11.641 | E11.65  
E13.00-E13.01 | E13.10-E13.11  
E13.641 | E13.8-E13.9  
G35 | G51.0  
I97.2 | K12.1-K12.2  
L10.0-L10.5 | L10.81  
L11.0 | L40.0-L40.9  
L87.0 | L87.2  
M05.09 | M05.20  
M05.311-M05.379 | M05.39-M05.40  
M05.511-M05.579 | M05.59-M05.60  
M05.711-M05.779 | M05.79-M05.80  
M06.00 | M06.011-M06.079  
M06.20 | M06.211-M06.279  
M06.38-M06.4 | M06.80  
M08.00 | M08.011-M08.079  
M08.211-M08.279 | M08.28-M08.29  
M08.411-M08.479 | M08.48  
M08.88-M08.90 | M08.911-M08.879  
M32.10-M32.19 | M32.8-M32.9  
M34.9 | M35.00-M35.09  
M75.00-M75.02 | M75.30-M75.32  
M75.90-M75.92 | M77.9  
T86.290 | T86.298  
T86.90-T86.99 | T86.30-T86.49  

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

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

B. Whether the medical treatment, procedure, drug, device, or biological product requires further studies or clinical trials to determine its maximum tolerated dose, toxicity, safety, effectiveness, or effectiveness as compared with the standard means of treatment or diagnosis, must improve health outcomes, according to the consensus of opinion among experts as shown by reliable evidence, including:
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1. Consultation with the Blue Cross and Blue Shield Association TEC or other nonaffiliated technology evaluation center(s);
2. Credible scientific evidence published in peer-reviewed medical literature generally recognized by the relevant medical community; or
3. Reference to federal regulations.

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   A. In accordance with nationally accepted standards of medical practice;
   B. Clinically appropriate, in terms of type, frequency, extent, level of care, site and duration, and considered effective for the patient's illness, injury or disease; and
   C. Not primarily for the personal comfort or convenience of the patient, physician or other health care provider, and not more costly than an alternative service or sequence of services at least as likely to produce equivalent therapeutic or diagnostic results as to the diagnosis or treatment of that patient's illness, injury or disease.

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