MASSACHUSETTS

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Medical Policy
Plasma Exchange

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Policy Number: 466

BCBSA Reference Number: 8.02.02 (For Plan internal use only)

Related Policies

Immune Globulin Therapy, #310
Lipid Apheresis, #465

Policy

Commercial Members: Managed Care (HMO and POS), PPO, and Indemnity

Plasma exchange may be considered **MEDICALLY NECESSARY** for the conditions listed below:

Autoimmune

- Severe multiple manifestations of mixed cryoglobulinemia (MC) such as cryoglobulinemic nephropathy, skin ulcers, sensory motor neuropathy, and widespread vasculitis in combination with immunosuppressive treatment
- Catastrophic antiphospholipid syndrome.

Hematologic

- ABO incompatible hematopoietic progenitor cell transplantation
- Hyperviscosity syndromes associated with multiple myeloma or Waldenstrom's macroglobulinemia
- Idiopathic thrombocytopenic purpura in emergency situations
- Thrombotic thrombocytopenic purpura (TTP)
- Atypical hemolytic-uremic syndrome
- Post-transfusion purpura, and
- HELLP syndrome of pregnancy (a severe form of preeclampsia, characterized by hemolysis [H], elevated liver enzymes [EL], and low platelet [LP] counts)
- Myeloma with acute renal failure.

Neurological

- Acute inflammatory demyelinating polyneuropathy (Guillain-Barré syndrome [GBS]; severity grade 1–2 within 2 weeks of onset; severity grade 3–5 within 4 weeks of onset; and children younger than 10-years-old with severe GBS)
- Chronic inflammatory demyelinating polyradiculoneuropathy (CIDP)

- Multiple sclerosis (MS); acute fulminant central nervous system (CNS) demyelination
- Myasthenia gravis in crisis or as part of preoperative preparation, and
- Paraproteinemia polyneuropathy; IgA, IgG.

Renal
- Anti-glomerular basement membrane disease (Goodpasture's syndrome), and
- ANCA [antineutrophil cytoplasmic antibody]-associated vasculitis (e.g., Wegener's granulomatosis [also known as granulomatosis with polyangitis (GPA)] with associated renal failure)
- Dense deposit disease with factor H deficiency and/or elevated C3 Nephritic factor.

Transplantation
- ABO incompatible solid organ transplantation
  - Kidney
  - Heart (infants), and
- Renal transplantation: antibody mediated rejection; HLA desensitization
- Focal segmental glomulerulosclerosis after renal transplant.

Plasma exchange is **INVESTIGATIONAL** in all other conditions, including, but not limited, to the following:
- ABO-incompatible solid organ transplant; liver,
- Acute disseminated encephalomyelitis,
- Acute inflammatory demyelinating polyneuropathy (Guillain-Barre syndrome) in children younger than 10-years-old with mild or moderate forms,
- Acute liver failure,
- Amyotrophic lateral sclerosis,
- ANCA [antineutrophil cytoplasmic antibody]-associated rapidly progressive glomerulonephritis (Wegener's granulomatosis or GPA without renal failure),
- Aplastic anemia,
- Asthma,
- Autoimmune hemolytic anemia; warm autoimmune hemolytic anemia; cold agglutinin disease,
- Chronic fatigue syndrome,
- Coagulation factor inhibitors,
- Cryoglobulinemia; except for severe mixed cryoglobulinemia, as noted above,
- Dermatomyositis and polymyositis,
- Focal segmental glomerulosclerosis (other than after renal transplant),
- Heart transplant rejection treatment,
- Hemolytic uremic syndrome (HUS); typical (diarrheal-related),
- Idiopathic thrombocytopenic purpura; refractory or non-refractory,
- Inclusion body myositis,
- Lambert-Eaton myasthenic syndrome,
- Multiple sclerosis with chronic progressive or relapsing remitting course,
- Mushroom poisoning,
- Myasthenia gravis with anti-MuSK antibodies,
- Neuromyelitis optica (NMO),
- Overdose and poisoning (other than mushroom poisoning),
- Paraneoplastic syndromes,
- Paraproteinemia polyneuropathy; IgM,
- Pediatric autoimmune neuropsychiatric disorders associated with streptococcal infections (PANDAS),
- Pemphigus vulgaris,
- Phytanic acid storage disease (Refsum's disease),
- POEMS (polyneuropathy, organomegaly, endocrinopathy, M protein, skin changes),
- Psoriasis,
- Red blood cell alloimmunization in pregnancy,
- Rheumatoid arthritis,

- Sepsis,
- Scleroderma (systemic sclerosis),
- Stiff person syndrome,
- Sydenham's chorea (SC),
- Systemic lupus erythematosus (including SLE [systemic lupus erythematosus] nephritis), and
- Thyrotoxicosis
- Hyperviscosity syndromes with renal failure (other than associated with multiple myeloma or Waldenstrom's macroglobulinemia).

Medicare HMO Blue[SM] and Medicare PPO Blue[SM] Members

Medical necessity criteria and coding guidance can be found through the link below.

National Coverage Determinations (NCDs)

National Coverage Determination (NCD) for APHERESIS (Therapeutic Pheresis) (110.14)

Note: To review the specific NCD, please remember to click "accept" on the CMS licensing agreement at the bottom of the CMS webpage.

Prior Authorization Information

Inpatient

- For services described in this policy, precertification/preauthorization **IS REQUIRED** for all products if the procedure is performed **inpatient**.

Outpatient

- For services described in this policy, see below for products where prior authorization **might be required** if the procedure is performed **outpatient**.

	Outpatient
Commercial Managed Care (HMO and POS)	Prior authorization is **not required**.
Commercial PPO and Indemnity	Prior authorization is **not required**.

CPT Codes / HCPCS Codes / ICD Codes

Inclusion or exclusion of a code does not constitute or imply member coverage or provider reimbursement. Please refer to the member's contract benefits in effect at the time of service to determine coverage or non-coverage as it applies to an individual member.

Providers should report all services using the most up-to-date industry-standard procedure, revenue, and diagnosis codes, including modifiers where applicable.

The following codes are included below for informational purposes only; this is not an all-inclusive list.

The above medical necessity criteria MUST be met for the following codes to be covered for Commercial Members: Managed Care (HMO and POS), PPO, and Indemnity:

CPT Codes

CPT codes:	Code Description
36514	Therapeutic apheresis; for plasma pheresis

The following ICD Diagnosis Codes are considered medically necessary when submitted with the CPT code above if medical necessity criteria are met:

ICD-10 Diagnosis Codes

ICD-10-CM Diagnosis codes:	Code Description
C90.00	Multiple myeloma not having achieved remission
C88.0	Waldenstrom macroglobulinemia
C90.01	Multiple myeloma in remission
C90.02	Multiple myeloma in relapse
D59.30	Hemolytic-uremic syndrome, unspecified
D59.31	Infection-associated hemolytic-uremic syndrome
D59.32	Hereditary hemolytic-uremic syndrome
D59.39	Other hemolytic-uremic syndrome
D69.3	Immune thrombocytopenic purpura
D69.51	Posttransfusion purpura
D75.1	Secondary polycythemia
D89.1	Cryoglobulinemia
G35	Multiple sclerosis
G36.1	Acute and subacute hemorrhagic leukoencephalitis [Hurst]
G36.8	Other specified acute disseminated demyelination
G36.9	Acute disseminated demyelination, unspecified
G37.4	Subacute necrotizing myelitis of central nervous system
G37.8	Other specified demyelinating diseases of central nervous system
G37.9	Demyelinating disease of central nervous system, unspecified
G61.0	Guillain-Barre syndrome
G61.81	Chronic inflammatory demyelinating polyneuritis
G62.81	Critical illness polyneuropathy
G70.00	Myasthenia gravis without (acute) exacerbation
G70.01	Myasthenia gravis with (acute) exacerbation
M30.1	Polyarteritis with lung involvement [Churg-Strauss]
M31.0	Hypersensitivity angiitis
M31.10	Thrombotic microangiopathy, unspecified
M31.11	Hematopoietic stem cell transplantation-associated thrombotic microangiopathy [HSCT-TMA]
M31.19	Other thrombotic microangiopathy
M31.30	Wegener's granulomatosis without renal involvement
M31.31	Wegener's granulomatosis with renal involvement
N00.6	Acute nephritic syndrome with dense deposit disease
N02.6	Recurrent and persistent hematuria with dense deposit disease
N03.6	Chronic nephritic syndrome with dense deposit disease
N04.6	Nephrotic syndrome with dense deposit disease
N19	Unspecified kidney failure
O14.10	Severe pre-eclampsia, unspecified trimester
O14.12	Severe pre-eclampsia, second trimester
O14.13	Severe pre-eclampsia, third trimester
O14.20	HELLP syndrome (HELLP), unspecified trimester
O14.22	HELLP syndrome (HELLP), second trimester
O14.23	HELLP syndrome (HELLP), third trimester
T86.11	Kidney transplant rejection
T86.21	Heart transplant rejection
T86.31	Heart-lung transplant rejection

Description

Plasma exchange (PE) is a procedure in which the plasma is isolated, then discarded and replaced with a substitution fluid such as albumin. Plasma exchange is a nonspecific therapy, since the entire plasma is discarded. PE has been used in a wide variety of acute and chronic conditions, as well as in the setting of solid organ transplantation.

The terms therapeutic apheresis, plasmapheresis, and plasma exchange (PE) are often used interchangeably but when properly used denote different procedures. The American Society for Apheresis (ASFA) definitions for these procedures is as follows:

- *Apheresis*: A procedure in which blood of the patient or donor is passed through a medical device which separates out one or more components of blood and returns remainder with or without extracorporeal treatment or replacement of the separated component.
- *Plasmapheresis:* A procedure in which blood of a patient or the donor is passed through a medical device which separates out plasma from the other components of blood and the plasma is removed (i.e., less than 15% of total plasma volume) without the use of replacement solution.
- *Plasma exchange*: A therapeutic procedure in which blood of the patient is passed through a medical device which separates out plasma from other components of blood, the plasma is removed and replaced with a replacement solution such as colloid solution (e.g., albumin and/ or plasma) or a combination of crystalloid/colloid solution.

PE is essentially a symptomatic therapy, since it does not remove the source of the pathogenic factors. Therefore the success of PE will depend on whether the pathogenic substances are accessible through the circulation and whether their rate of production and transfer to the plasma component can be adequately addressed by PE.

Applications of PE can be broadly subdivided into two general categories: 1) acute self-limited diseases, in which PE is used to acutely lower the circulating pathogenic substance; and 2) chronic diseases, in which there is ongoing production of pathogenic autoantibodies.

In addition, plasmapheresis has been used as a technique to desensitize high-risk patients prior to transplant and also as a treatment of antibody-mediated rejection reaction (AMR) occurring after transplant.

Providers should report all services using the most up-to-date industry-standard procedure, revenue, and diagnosis codes, including modifiers where applicable.

Summary

Plasma exchange (PE) is a procedure in which the plasma is isolated, then discarded and replaced with a substitution fluid such as albumin. PE is a nonspecific therapy, because the entire plasma is discarded. PE has been used in a wide variety of acute and chronic conditions, as well as in the setting of solid organ transplantation.

Due to data from published studies and/or clinical support, PE is considered medically necessary for selected conditions. For conditions in which there is a lack of efficacy data and clinical support, PE is considered investigational.

Policy History

Date	Action
10/2022	Clarified coding information.
10/2021	Clarified coding information.
1/2021	Medicare information removed. See MP #132 Medicare Advantage Management for local coverage determination and national coverage determination reference.
10/2017	Annual policy review. New references added.
10/2015	Annual policy review. New investigational indications described. Effective 10/1/2015.

	NCD/LCD: National Coverage Determination (NCD) for APHERESIS (Therapeutic Pheresis) (110.14) added.
7/2014	Annual policy review. Minor changes to bullet points on multiple sclerosis for clarity only.
6/2014	Updated Coding section with ICD10 procedure and diagnosis codes. Effective 10/2015.
4/2014	Clarified coding information.
6/2013	Annual policy review. New references added.
2/2013	Annual policy review. Changes to policy statements. Effective 2/4/2013.
11/2011-4/2012	Medical policy ICD 10 remediation: Formatting, editing and coding updates. No changes to policy statements.
7/2011	Reviewed - Medical Policy Group - Hematology and Oncology. No changes to policy statements.
6/2/2011	Annual policy review. Changes to policy statements
4/2011	Reviewed - Medical Policy Group - Cardiology and Pulmonology. No changes to policy statements.
9/2010	Reviewed - Medical Policy Group - Hematology and Oncology. No changes to policy statements.
6/2010	Annual policy review. Changes to policy statements
4/2010	Reviewed - Medical Policy Group - Cardiology and Pulmonology. No changes to policy statements.
9/2009	Reviewed - Medical Policy Group - Hematology and Oncology. No changes to policy statements.
5/2009	Annual policy review. No changes to policy statements.
4/2009	Reviewed - Medical Policy Group - Cardiology and Pulmonology. No changes to policy statements.
3/2009	Annual policy review. Changes to policy statements
11/2008	Annual policy review. Changes to policy statements
10/2008	Reviewed - Medical Policy Group - Hematology and Oncology. No changes to policy statements.
5/2008	Annual policy review. No changes to policy statements.
4/2008	Reviewed - Medical Policy Group - Cardiology and Pulmonology. No changes to policy statements.
4/2008	Annual policy review. Changes to policy statements
1/2008	Reviewed - Medical Policy Group - Neurology and Neurosurgery. No changes to policy statements.
2/2008	Annual policy review. No changes to policy statements.
9/2007	Reviewed - Medical Policy Group - Hematology and Oncology. No changes to policy statements.
4/2007	Reviewed - Medical Policy Group - Cardiology and Pulmonology. No changes to policy statements.
1/2007	Reviewed - Medical Policy Group - Neurology and Neurosurgery. No changes to policy statements.

Information Pertaining to All Blue Cross Blue Shield Medical Policies

Click on any of the following terms to access the relevant information:

Medical Policy Terms of Use
Managed Care Guidelines
Indemnity/PPO Guidelines
Clinical Exception Process
Medical Technology Assessment Guidelines

References

1. Food and Drug Administration (FDA). Compliance Program Guidance Manual; Chapter 42- Blood and Blood Products. 2011; https://www.fda.gov/downloads/Enforcement/UCM247371.pdf. Accessed August 4, 2017.
2. Shumak KH, Rock GA. Therapeutic plasma exchange. *N Engl J Med.* Mar 22 1984;310(12):762-771. PMID 6199669
3. Kronbichler A, Brezina B, Quintana LF, et al. Efficacy of plasma exchange and immunoadsorption in systemic lupus erythematosus and antiphospholipid syndrome: A systematic review. *Autoimmun Rev.* Jan 2016;15(1):3849. PMID 26318215
4. Lewis EJ, Hunsicker LG, Lan SP, et al. A controlled trial of plasmapheresis therapy in severe lupus nephritis. The Lupus Nephritis Collaborative Study Group. *N Engl J Med.* May 21 1992;326(21):1373-1379. PMID 1569973
5. Danieli MG, Palmieri C, Salvi A, et al. Synchronised therapy and high-dose cyclophosphamide in proliferative lupus nephritis. *J Clin Apher.* 2002;17(2):72-77. PMID 12210709
6. Khatri BO, McQuillen MP, Harrington GJ, et al. Chronic progressive multiple sclerosis: double-blind controlled study of plasmapheresis in patients taking immunosuppressive drugs. *Neurology.* Mar 1985;35(3):312-319. PMID 3974889
7. Weiner HL, Dau PC, Khatri BO, et al. Double-blind study of true vs. sham plasma exchange in patients treated with immunosuppression for acute attacks of multiple sclerosis. *Neurology.* Sep 1989;39(9):1143-1149. PMID 2549450
8. Canadian Cooperative Multiple Sclerosis Study Group. The Canadian cooperative trial of cyclophosphamide and plasma exchange in progressive multiple sclerosis. The Canadian Cooperative Multiple Sclerosis Study Group. *Lancet.* Feb 23 1991;337(8739):441-446. PMID 1671468
9. Tim RW, Massey JM, Sanders DB. Lambert-Eaton myasthenic syndrome: electrodiagnostic findings and response to treatment. *Neurology.* Jun 13 2000;54(11):2176-2178. PMID 10851390
10. Sanders DB, Massey JM, Sanders LL, et al. A randomized trial of 3,4-diaminopyridine in Lambert-Eaton myasthenic syndrome. *Neurology.* Feb 08 2000;54(3):603-607. PMID 10680790
11. Anderson NE, Rosenblum MK, Posner JB. Paraneoplastic cerebellar degeneration: clinical-immunological correlations. *Ann Neurol.* Oct 1988;24(4):559-567. PMID 3239956
12. Dwosh IL, Giles AR, Ford PM, et al. Plasmapheresis therapy in rheumatoid arthritis. A controlled, double-blind, crossover trial. *N Engl J Med.* May 12 1983;308(19):1124-1129. PMID 6339939
13. Miller FW, Leitman SF, Cronin ME, et al. Controlled trial of plasma exchange and leukapheresis in polymyositis and dermatomyositis. *N Engl J Med.* May 21 1992;326(21):1380-1384. PMID 1472183
14. Guillaume JC, Roujeau JC, Morel P, et al. Controlled study of plasma exchange in pemphigus. *Arch Dermatol.* Nov 1988;124(11):1659-1663. PMID 3178248
15. Vicari AM, Folli F, Pozza G, et al. Plasmapheresis in the treatment of stiff-man syndrome. *N Engl J Med.* Jun 01 1989;320(22):1499. PMID 2716805
16. Brashear HR, Phillips LH, 2nd. Autoantibodies to GABAergic neurons and response to plasmapheresis in stiff-man syndrome. *Neurology.* Oct 1991;41(10):1588-1592. PMID 1922799
17. Harding AE, Thompson PD, Kocen RS, et al. Plasma exchange and immunosuppression in the stiff man syndrome. *Lancet.* Oct 14 1989;2(8668):915. PMID 2571826
18. Pagano MB, Murinson BB, Tobian AA, et al. Efficacy of therapeutic plasma exchange for treatment of stiff-person syndrome. *Transfusion.* Jul 2014;54(7):1851-1856. PMID 24527774
19. Pham HP, Williams LA, 3rd. Therapeutic plasma exchange in two patients with stiff-person syndrome. *J Clin Apher.* Oct 2016;31(5):493-494. PMID 26407506
20. Rockx MA, Clark WF. Plasma exchange for treating cryoglobulinemia: a descriptive analysis. *Transfus Apher Sci.* Jun 2010;42(3):247-251. PMID 20382569
21. Michael M, Elliott EJ, Craig JC, et al. Interventions for hemolytic uremic syndrome and thrombotic thrombocytopenic purpura: a systematic review of randomized controlled trials. *Am J Kidney Dis.* Feb 2009;53(2):259-272. PMID 18950913
22. Noris M, Remuzzi G. Atypical hemolytic-uremic syndrome. *N Engl J Med.* Oct 22 2009;361(17):1676-1687. PMID 19846853
23. Yu X, Gan L, Wang Z, et al. Chemotherapy with or without plasmapheresis in acute renal failure due to multiple myeloma: a meta-analysis. *Int J Clin Pharmacol Ther.* May 2015;53(5):391-397. PMID 25816886
24. Chevret S, Hughes RA, Annane D. Plasma exchange for Guillain-Barre syndrome. *Cochrane Database Syst Rev.* Feb 27 2017;2:Cd001798. PMID 28241090
25. El-Bayoumi MA, El-Refaey AM, Abdelkader AM, et al. Comparison of intravenous immunoglobulin and plasma exchange in treatment of mechanically ventilated children with Guillain Barre syndrome: a randomized study. *Crit Care.* Jul 11 2011;15(4):R164. PMID 21745374
26. Mehndiratta MM, Hughes RA, Pritchard J. Plasma exchange for chronic inflammatory demyelinating polyradiculoneuropathy. *Cochrane Database Syst Rev.* Aug 25 2015;8(8):CD003906. PMID 26305459

27. Weinshenker BG, O'Brien PC, Petterson TM, et al. A randomized trial of plasma exchange in acute central nervous system inflammatory demyelinating disease. *Ann Neurol.* Dec 1999;46(6):878-886. PMID 10589540
28. Kohler W, Bucka C, Klingel R. A randomized and controlled study comparing immunoadsorption and plasma exchange in myasthenic crisis. *J Clin Apher.* Dec 2011;26(6):347-355. PMID 22095647
29. Alipour-Faz A, Shojaei M, Peyvandi H. A comparison between IVIG and plasma exchange as preparations before thymectomy in myasthenia gravis patients. Mar 2017;117(1):245-249. PMID 27530310
30. Dyck PJ, Low PA, Windebank AJ, et al. Plasma exchange in polyneuropathy associated with monoclonal gammopathy of undetermined significance. *N Engl J Med.* Nov 21 1991;325(21):1482-1486. PMID 1658648
31. Abboud H, Petrak A, Mealy M, et al. Treatment of acute relapses in neuromyelitis optica: Steroids alone versus steroids plus plasma exchange. *Mult Scler.* Feb 2016;22(2):185-192. PMID 25921047
32. Bonnan M, Valentino R, Olindo S, et al. Plasma exchange in severe spinal attacks associated with neuromyelitis optica spectrum disorder. *Mult Scler.* Apr 2009;15(4):487-492. PMID 19324982
33. Merle H, Olindo S, Jeannin S, et al. Treatment of optic neuritis by plasma exchange (add-on) in neuromyelitis optica. *Arch Ophthalmol.* Jul 2012;130(7):858-862. PMID 22776923
34. Kleiter I, Gahlen A, Borisow N, et al. Neuromyelitis optica: Evaluation of 871 attacks and 1,153 treatment courses. *Ann Neurol.* Feb 2016;79(2):206-216. PMID 26537743
35. Ipe TS, Pham HP, Williams LA, 3rd. Critical updates in the 7th edition of the American Society for Apheresis guidelines. *J Clin Apher.* Jun 27 2017. PMID 28653762
36. DeSena AD, Noland DK, Matevosyan K, et al. Intravenous methylprednisolone versus therapeutic plasma exchange for treatment of anti-N-methyl-D-aspartate receptor antibody encephalitis: A retrospective review. *J Clin Apher.* Aug 2015;30(4):212-216. PMID 25664728
37. Khatri BO, Man S, Giovannoni G, et al. Effect of plasma exchange in accelerating natalizumab clearance and restoring leukocyte function. *Neurology.* Feb 03 2009;72(5):402-409. PMID 19188571
38. Couser WG. Rapidly progressive glomerulonephritis: classification, pathogenetic mechanisms, and therapy. *Am J Kidney Dis.* Jun 1988;11(6):449-464. PMID 3287904
39. Cole E, Cattran D, Magil A, et al. A prospective randomized trial of plasma exchange as additive therapy in idiopathic crescentic glomerulonephritis. The Canadian Apheresis Study Group. *Am J Kidney Dis.* Sep 1992;20(3):261-269. PMID 1519607
40. Walsh M, Catapano F, Szpirt W, et al. Plasma exchange for renal vasculitis and idiopathic rapidly progressive glomerulonephritis: a meta-analysis. *Am J Kidney Dis.* Apr 2011;57(4):566-574. PMID 21194817
41. Jayne DR, Gaskin G, Rasmussen N, et al. Randomized trial of plasma exchange or high-dosage methylprednisolone as adjunctive therapy for severe renal vasculitis. *J Am Soc Nephrol.* Jul 2007;18(7):21802188. PMID 17582159
42. Walsh M, Casian A, Flossmann O, et al. Long-term follow-up of patients with severe ANCA-associated vasculitis comparing plasma exchange to intravenous methylprednisolone treatment is unclear. *Kidney Int.* Aug 2013;84(2):397-402. PMID 23615499
43. Montgomery RA, Zachary AA. Transplanting patients with a positive donor-specific crossmatch: a single center's perspective. *Pediatr Transplant.* Dec 2004;8(6):535-542. PMID 15598320
44. Jordan SC, Vo AA, Tyan D, et al. Current approaches to treatment of antibody-mediated rejection. *Pediatr Transplant.* Jun 2005;9(3):408-415. PMID 15910400
45. Lehrich RW, Rocha PN, Reinsmoen N, et al. Intravenous immunoglobulin and plasmapheresis in acute humoral rejection: experience in renal allograft transplantation. *Hum Immunol.* Apr 2005;66(4):350-358. PMID 15866697
46. Ibernon M, Gil-Vernet S, Carrera M, et al. Therapy with plasmapheresis and intravenous immunoglobulin for acute humoral rejection in kidney transplantation. *Transplant Proc.* Nov 2005;37(9):3743-3745. PMID 16386524
47. Gubensek J, Buturovic-Ponikvar J, Kandus A, et al. Plasma exchange and intravenous immunoglobulin in the treatment of antibody-mediated rejection after kidney transplantation: a single-center historic cohort study. *Transplant Proc.* May 2013;45(4):1524-1527. PMID 23726611
48. Larsen FS, Schmidt LE, Bernsmeier C, et al. High-volume plasma exchange in patients with acute liver failure: An open randomised controlled trial. *J Hepatol.* Jan 2016;64(1):69-78. PMID 26325537
49. Ellingsen I, Florvaag E, Andreassen AH, et al. Plasmapheresis in the treatment of steroid-dependent bronchial asthma. *Allergy.* Dec 2001;56(12):1202-1205. PMID 11736751
50. Rimmer E, Houston BL, Kumar A, et al. The efficacy and safety of plasma exchange in patients with sepsis and septic shock: a systematic review and meta-analysis. *Crit Care.* Dec 20 2014;18(6):699. PMID 25527094

51. Perlmutter SJ, Leitman SF, Garvey MA, et al. Therapeutic plasma exchange and intravenous immunoglobulin for obsessive-compulsive disorder and tic disorders in childhood. *Lancet.* Oct 02 1999;354(9185):1153-1158. PMID 10513708
52. Garvey MA, Snider LA, Leitman SF, et al. Treatment of Sydenham's chorea with intravenous immunoglobulin, plasma exchange, or prednisone. *J Child Neurol.* May 2005;20(5):424-429. PMID 15968928
53. National Comprehensive Cancer Network (NCCN). NCCN Clinical Practice Guidelines in Oncology: Multiple Myeloma. Version 2.2018. https://www.nccn.org/professionals/physician_gls/pdf/myeloma.pdf. Accessed September 29, 2017.
54. Cortese I, Chaudhry V, So YT, et al. Evidence-based guideline update: Plasmapheresis in neurologic disorders: report of the Therapeutics and Technology Assessment Subcommittee of the American Academy of Neurology. *Neurology.* Jan 18 2011;76(3):294-300. PMID 21242498
55. Hughes RA, Wijdicks EF, Barohn R, et al. Practice parameter: immunotherapy for Guillain-Barre syndrome: report of the Quality Standards Subcommittee of the American Academy of Neurology. *Neurology.* Sep 23 2003;61(6):736-740. PMID 14504313
56. Schwartz J, Padmanabhan A, Aqui N, et al. Guidelines on the use of therapeutic apheresis in clinical practice-evidence-based approach from the Writing Committee of the American Society for Apheresis: The Seventh Special Issue. *J Clin Apher.* Jun 2016;31(3):149-162. PMID 27322218
57. Schwartz J, Winters JL, Padmanabhan A, et al. Guidelines on the use of therapeutic apheresis in clinical practice-evidence-based approach from the Writing Committee of the American Society for Apheresis: the sixth special issue. *J Clin Apher.* Jul 2013;28(3):145-284. PMID 23868759
58. Centers for Medicare & Medicaid Services (CMS). National Coverage Determination (NCD) for Apheresis (therapeutic pheresis) (110.14). 1992; https://www.cms.gov/medicare-coverage-database/details/ncd-details.aspx?ncdid=82&ver=1. Accessed August 4, 2017.