December 6, 2021

American Society of Health-System Pharmacists
American Hospital Formulary Service Drug Information
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Dear Sir or Madam:

As a compendium recognized by the Centers for Medicare and Medicaid Services (CMS), Medicare Part D plans utilize the information in AHFS® Drug Information® for determination of medically-accepted off-label indications. This determination is critical, as it dictates whether a drug claim will be reliably paid by a Medicare Part D plan for a specific beneficiary. Current monographs for many immunosuppressive drugs in AHFS® Drug Information® do not adequately address off-label organ transplant uses. As a result, transplant recipients are vulnerable to, and some have experienced, denial of coverage by Part D plans for their lifesaving immunosuppressive drug therapy.

The American Society of Transplantation (AST) became aware of this issue in 2016 and formalized a position (Appendix A). Per our proposed approaches for resolution, we hereby implore you to review your AHFS® Drug Information® content on the following drugs, and consider expanding your “Uses” section to include the off-label indications listed below (these are also summarized in Appendix B):

1) Tacrolimus:
   a. Add pancreas transplant rejection, prophylaxis
   b. Add intestine transplant rejection, prophylaxis
   c. Add vascular composite allograft rejection, prophylaxis

2) Cyclosporine
   a. Add lung transplant rejection, prophylaxis
   b. Add pancreas transplant rejection, prophylaxis

3) Mycophenolate mofetil
   a. Add pancreas transplant rejection, prophylaxis
   b. Add intestine transplant rejection, prophylaxis
   c. Add vascular composite allograft rejection, prophylaxis

4) Mycophenolate sodium
   a. Add liver transplant rejection, prophylaxis
   b. Add heart transplant rejection, prophylaxis
   c. Add pancreas transplant rejection, prophylaxis
   d. Add vascular composite allograft rejection, prophylaxis

5) Azathioprine
   a. Add liver transplant rejection, prophylaxis

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b. Add heart transplant rejection, prophylaxis
c. Add lung transplant rejection, prophylaxis
d. Add pancreas transplant rejection, prophylaxis
e. Add intestine transplant rejection, prophylaxis
f. Add vascular composite allograft rejection, prophylaxis

2) Sirolimus
   a. Add liver transplant rejection, prophylaxis
   b. Add heart transplant rejection, prophylaxis
   c. Add lung transplant rejection, prophylaxis
   d. Add pancreas transplant rejection, prophylaxis
   e. Add intestine transplant rejection, prophylaxis
   f. Add vascular composite allograft rejection, prophylaxis

3) Everolimus
   a. Add heart transplant rejection, prophylaxis
   b. Add lung transplant rejection, prophylaxis
   c. Add pancreas transplant rejection, prophylaxis
   d. Add vascular composite allograft rejection, prophylaxis

4) Belatacept
   a. Add liver transplant rejection, prophylaxis
   b. Add heart transplant rejection, prophylaxis
   c. Add lung transplant rejection, prophylaxis
   d. Add pancreas transplant rejection, prophylaxis
   e. Add vascular composite allograft rejection, prophylaxis
   f. Add heart transplant, pre-transplant desensitization

5) Basiliximab
   a. Add liver transplant rejection, prophylaxis
   b. Add heart transplant rejection, prophylaxis
   c. Add lung transplant rejection, prophylaxis
   d. Add pancreas transplant rejection, prophylaxis
   e. Add intestine transplant rejection, prophylaxis
   f. Add vascular composite allograft rejection, prophylaxis

6) Rabbit antithymocyte globulin
   a. Add liver transplant rejection, prophylaxis
   b. Add heart transplant rejection, prophylaxis
   c. Add lung transplant rejection, prophylaxis
   d. Add pancreas transplant rejection, prophylaxis
   e. Add intestine transplant rejection, prophylaxis
   f. Add vascular composite allograft rejection, prophylaxis
   g. Add liver transplant rejection, treatment
   h. Add heart transplant rejection, treatment
   i. Add lung transplant rejection, treatment
   j. Add pancreas transplant rejection, treatment
   k. Add vascular composite allograft rejection, treatment

7) Alemtuzumab
   a. Add kidney transplant rejection, prophylaxis
   b. Add heart transplant rejection, prophylaxis

c. Add lung transplant rejection, prophylaxis
d. Add pancreas transplant rejection, prophylaxis
e. Add intestine transplant rejection, prophylaxis
f. Add vascular composite allograft rejection, prophylaxis
g. Add kidney transplant rejection, treatment
h. Add lung transplant rejection, treatment
i. Add vascular composite allograft rejection, treatment

8) Immune globulin
   a. Add kidney transplant rejection, treatment
   b. Add liver transplant rejection, treatment
   c. Add heart transplant rejection, treatment
   d. Add lung transplant rejection, treatment
   e. Add pancreas transplant rejection, treatment
   f. Add intestine transplant rejection, treatment
   g. Add vascular composite allograft rejection, treatment
   h. Add kidney transplant, pre-transplant desensitization
   i. Add liver transplant, pre-transplant desensitization
   j. Add heart transplant, pre-transplant desensitization
   k. Add intestine transplant, pre-transplant desensitization

9) Rituximab
   a. Add intestine transplant rejection, prophylaxis
   b. Add kidney transplant rejection, treatment
   c. Add liver transplant rejection, treatment
   d. Add heart transplant rejection, treatment
   e. Add lung transplant rejection, treatment
   f. Add pancreas transplant rejection, treatment
   g. Add intestine transplant rejection, treatment
   h. Add vascular composite allograft rejection, treatment
   i. Add kidney transplant, pre-transplant desensitization
   j. Add liver transplant, pre-transplant desensitization
   k. Add heart transplant, pre-transplant desensitization

10) Bortezomib
   a. Add kidney transplant rejection, treatment
   b. Add liver transplant rejection, treatment
   c. Add heart transplant rejection, treatment
   d. Add lung transplant rejection, treatment
   e. Add pancreas transplant rejection, treatment
   f. Add intestine transplant rejection, treatment
   g. Add vascular composite allograft rejection, treatment
   h. Add kidney transplant, pre-transplant desensitization
   i. Add heart transplant, pre-transplant desensitization

11) Carfilzomib
   a. Add lung transplant rejection, treatment
   b. Add kidney transplant, pre-transplant desensitization
   c. Add heart transplant, pre-transplant desensitization

12) Eculizumab
   a. Add heart transplant rejection, prophylaxis
   b. Add kidney transplant rejection, treatment

c. Add liver transplant rejection, treatment
d. Add heart transplant rejection, treatment
e. Add lung transplant rejection, treatment
f. Add pancreas transplant rejection, treatment
g. Add intestine transplant rejection, treatment
h. Add vascular composite allograft rejection, treatment
i. Add kidney transplant, pre-transplant desensitization

13) Tocilizumab
a. Add kidney transplant rejection, treatment
b. Add kidney transplant, pre-transplant desensitization

14) Adalimumab
a. Add intestine transplant rejection, treatment

15) Infliximab
a. Add intestine transplant rejection, treatment

We realize that you require at least one citation from the medical literature to support each of these revisions. We have reviewed the literature, and Appendix C contains the citations that we believe meet this need.

Thank you in advance for your attention to this matter,

Sincerely,

John Gill, MD, MS
President

Attachments:

- Appendix A: AST Position Statement on Immunosuppressant Drug Coverage Under Medicare Part D Benefit
- Appendix B: Overview of drug/indication pairs with on- or off-label indications already endorsed by AFHS (green) and those for which we request endorsement (yellow) with associated level of evidence
- Appendix C: Citations from the medical literature in support of the proposed off-label indication

Appendix A:

AST Position Statement on Immunosuppressant Drug Coverage Under Medicare Part D Benefit

https://www.myast.org/public-policy/key-position-statements/immunosuppressant-drug-coverage-under-medicare-part-d-benefit

Appendix B:

Overview of drug/indication pairs with on- or off-label indications already endorsed by AFHS (green) and those for which we request endorsement (yellow) with associated level of evidence

	Tacrolimus	Cyclosporine	Mycophenolate mofetil	Mycophenoate sodium	Azathioprine	Leflunomide	Prednisone/Prednisolone	Sirolimus	Everolimus	Belatacept	Basiliximab	Rabbit antithymocyte globulin	Alemtuzumab	Immune globulin	Rituximab	Bortezomib	Carfilzomib	Eculizumab	Tocilizumab	Adalimumab	Infliximab
To prevent rejection																					
Kidney													A								
Liver				B	B			A		C	A	B									
Heart				A	A			A	A	C	C	B	C					C			
Lung		A			A			A	A	C	B	B	B								
Pancreas	A	A	A	B	B			A	B	C	C	B	B								
Intestine	C		C		C			C			C	C	C		C						
Vascular Composite Allograft	C		C	C	C			C	C	C	C	C	C								
To treat rejection																					
Kidney													C	B	B	B		B	C		
Liver												C		C	C	C		C			
Heart												C		C	C	C		C			
Lung												C	C	B	C	C	C	C			
Pancreas												C		C	C	C		C			
Intestine														C	C	C		C		C	C
Vascular Composite Allograft												C	C	C	C	C		C			
For pre-transplant desensitization																					
Kidney														A	B	B	C	B	C		
Liver														C	C						
Heart										C				B	C	B	C				
Lung																					
Pancreas																					
Intestine														C							

Adapted from Lexi-Drugs ® Level of Evidence Scale

A. Evidence from well performed randomized, controlled trials or overwhelming evidence of some other form to support the off-label use

B.	Evidence from randomized, controlled trials with important limitations (e.g., inconsistent results, methodologic flaws, indirect, imprecise) or very strong evidence of some other research design
C.	Evidence from observational studies (e.g., retrospective case series/reports providing significant impact on patient care); unsystematic clinical experience; or potentially flawed randomized, controlled trials (e.g., when limited options exist for condition)

Appendix C:

Citations from the medical literature in support of the proposed off-label indication

1. Tacrolimus

    a. Add pancreas transplant rejection, prophylaxis
        i. Cattral M, Luke S, Knauer MJ, et al. Randomized open-label crossover assessment of Prograf vs Advagraf on immunosuppressant pharmacokinetics and pharmacodynamics in simultaneous pancreas-kidney patients. *Clin Transplant* 2018; e13180.
        ii. Ciancio G, Sageshima J, Chen L, et al. Advantage of rapamycin over mycophenolate mofetil when used with tacrolimus for simultaneous pancreas kidney transplants: randomized, single-center trial at 10 years. *Am J Transplant* 2012; 12(12): 3363-76.
        iii. Gruessner RW, Kandaswamy R, Humar A, et al. Calcineurin inhibitor- and steroid-free immunosuppression in pancreas-kidney and solitary pancreas transplantation. *Transplantation* 2005; 79(9): 1184-9.

    b. Add intestine transplant rejection, prophylaxis
        i. Grant D, Abu-Elmagd KM, Mazariegos G, et al. Intestinal transplant registry report: global activity and trends. *Am J Transplant* 2015; 15(1): 210-9.
        ii. Trevizol AP, David AI, Dias ER, et al. Intestinal and multivisceral transplantation immunosuppression protocols--literature review. *Transplantation Proc* 2012; 44(8), 2445-8.
        iii. Abu-Elmagd KM, Costa G, Bond GJ, et al. Five hundred intestinal and multivisceral transplantations at a single center: major advances with new challenges. *Ann Surg* 2009; 250(4): 567-81.
        iv. Reyes J, Mazariegos G, Starzl T, et al. Intestinal transplantation under tacrolimus monotherapy after perioperative lymphoid depletion with rabbit anti-thymocyte globulin (thymoglobulin). *Am J Transplant* 2005; 5(6), 1430-6.

    c. Add vascular composite allograft rejection, prophylaxis
        i. Johannesson L, Testa G, Putman JM, et al. Twelve live births after uterus transplantation in the Dallas UtErus transplant study. *Obstet Gynecol* 2021;137(2):241-249.
        ii. Tasigiorgos S, Kollar B, Turk M, et al. Five year follow-up after face transplantation. *N Engl J Med* 2019; 380:2579-2581.
        iii. Diaz-Siso JR, Fischer S, Sisk GC, et al. Initial experience of dual maintenance immunosuppression with steroid withdrawal in vascular composite tissue allotransplantation. Am J Transplant 2015;15(5):1421-31.
        iv. Brännström M, Johannesson L, Bokström H, et al. Livebirth after uterus transplantation. *Lancet* 2015;385(9968):607-616.
        v. Petruzzo P, Kanitakis J, Testelin S, et al. Clinicopathological findings of chronic rejection in a face grafted patient. *Transplantation* 2015; 99(12): 2644-50.
        vi. Kaufman CL, Ouseph R, Blair B, et al. Graft vasculopathy in clinical hand transplantation. *Am J Transplant* 2012;12(4):1004-16.

vii. Petruzzo P, Kanitakis J, Badet L, et al. Long-term follow-up incomposite tissue allotransplantation: in-depth study of five (hand and face) recipients. *Am J Transplant* 2011; 11: 808-16.
viii. Lantieri L, Hivelin M, Audard V, et al. Feasibility, reproducibility, risks and benefits of face transplantation: A prospective study of outcomes. *Am J Transplant* 2011; 11: 367-78
ix. Devauchelle B, Badet L, Lengele B, et al. First human face allograft: early report. *Lancet* 2006; 368: 203-09.
x. Jones JW, Gruber SA, Barker JH, et al. Successful hand transplantation: one year follow-up. *N Engl J Med* 2000;343:468-73.
xi. Dubernard JM, Owen E, Herzberg G, et al. Human hand allograft: report on first 6 months. *Lancet* 1999; 353: 1315-20.

2. Cyclosporine

    a. Add lung transplant rejection, prophylaxis
        i. Gottlieb J, Neurohr C, Muller-Quernheim J, et al. A randomized trial of everolimus-based quadruple therapy vs standard triple therapy early after lung transplantation. Am J Transplant 2019; 19: 1759-69.
        ii. Treede H, Glanville AR, Klepetko W, et al. Tacrolimus and cyclosporine have differential effects on the risk of development of bronchiolitis obliterans syndrome: results of a prospective, randomized international trial in lung transplantation. J Heart Lung Transplant 2012; 31: 797-804.

    b. Add pancreas transplant rejection, prophylaxis
        i. Knight RJ, Podder H, Kerman RH, et al. Comparing an early corticosteroid/late calcineurin-free immunosuppression protocol to a sirolimus-, cyclosporine A-, and prednisone-based regimen for pancreas-kidney transplantation. *Transplantation* 2010; 89(6): 727-32.
        ii. Rajab A, Pelletier RP, Ferguson RM, et al. Steroid-free maintenance immunosuppression with rapamune and low-dose neoral in pancreas transplant recipients. *Transplantation* 2007; 84(9): 1131-7.
        iii. Boggi U, Vistoli F, Del Chiaro M, et al. Neoral versus prograf in simultaneous pancreas-kidney transplantation with portal venous drainage: three-year results of a single-center, open-label, prospective, randomized pilot study. *Transplant Proc* 2005; 37(6): 2641-3.
        iv. Boggi U, Vistoli F, Del Chiaro M, et al. Single-center, open, prospective, randomized pilot study comparing cyclosporine versus tacrolimus in simultaneous pancreas-kidney transplantation. *Transplant Proc* 2004; 36(4): 1064-6.

3. Mycophenolate mofetil

    a. Add pancreas transplant rejection, prophylaxis
        i. Cantarovich D, Karam G, Hourmant M et al. Steroid avoidance versus steroid withdrawal after simultaneous pancreas-kidney transplantation. Am J Transplant 2005; 5(6): 1332-8.
        ii. Merion RM, Henry ML, Melzer JS, et al. Randomized, prospective trial of mycophenolate mofetil versus azathioprine for prevention of acute renal allograft rejection after simultaneous kidney-pancreas transplantation. *Transplantation* 2000; 70(1):105-11.
        iii. Stegall MD, Simon M, Wachs ME, et al. Mycophenolate mofetil decreases rejection in simultaneous pancreas-kidney transplantation when

combined with tacrolimus or cyclosporine. *Transplantation* 1997; 64(12): 1695-700.

b. Add intestine transplant rejection, prophylaxis
    i. Abu-Elmagd KM, Costa G, Bond GJ, et al. Five hundred intestinal and multivisceral transplantations at a single center: major advances with new challenges. *Ann Surg* 2009; 250(4): 567-81.

c. Add vascular composite allograft rejection, prophylaxis
    i. Tasigiorgos S, Kollar B, Turk M, et al. Five year follow-up after face transplantation. *N Engl J Med* 2019; 380:2579-2581.
    ii. Diaz-Siso JR, Fischer S, Sisk GC, et al. Initial experience of dual maintenance immunosuppression with steroid withdrawal in vascular composite tissue allotransplantation. Am J Transplant 2015;15(5):1421-31.
    iii. Petruzzo P, Kanitakis J, Testelin S, et al. Clinicopathological findings of chronic rejection in a face grafted patient. *Transplantation* 2015; 99(12): 2644-50.
    iv. Kaufman CL, Ouseph R, Blair B, et al. Graft vasculopathy in clinical hand transplantation. *Am J Transplant* 2012;12(4):1004-16.
    v. Petruzzo P, Kanitakis J, Badet L, et al. Long-term follow-up incomposite tissue allotransplantation: in-depth study of five (hand and face) recipients. *Am J Transplant* 2011; 11: 808-16.
    vi. Lantieri L, Hivelin M, Audard V, et al. Feasibility, reproducibility, risks and benefits of face transplantation: A prospective study of outcomes. *Am J Transplant* 2011; 11: 367-78
    vii. Devauchelle B, Badet L, Lengele B, et al. First human face allograft: early report. *Lancet* 2006; 368: 203-09.
    viii. Jones JW, Gruber SA, Barker JH, et al. Successful hand transplantation: one year follow-up. *N Engl J Med* 2000;343:468-73.
    ix. Dubernard JM, Owen E, Herzberg G, et al. Human hand allograft: report on first 6 months. *Lancet* 1999; 353: 1315-20.

4. Mycophenolate sodium

a. Add liver transplant rejection, prophylaxis
    i. Saliba F, Duvoux C, Gugenheim J, et al. Efficacy and safety of everolimus and mycophenolic acid with early tacrolimus withdrawal after liver transplantation: a multicenter randomized trial. *Am J Transplant* 2017; 17(7): 1843-52.
    ii. Wang Z, He JJ, Liu XY, et al. The evaluation of enteric-coated mycophenolate sodium in cardiac deceased donor liver transplant patients in China. *Immunopharmacol Immunotoxicol* 2015; 37(6): 508-12.
    iii. Manzia TM, Sforza D, Angelico R, et al. Everolimus and enteric-coated mycophenolate sodium ab initio after liver transplantation: midterm results. *Transplant Proc* 2012; 44(7): 1942-5.
    iv. Cantisani GP, Zanotelli ML, Gleisner AL, et al. Enteric-coated mycophenolate sodium experience in liver transplant patients. *Transplant Proc* 2006; 38(3): 932-3.

b. Add heart transplant rejection, prophylaxis

i. Lehmkuhl H, Hummel M, Kobashigawa J, et al. Enteric-coated mycophenolate-sodium in heart transplantation: efficacy, safety, and pharmacokinetic compared with mycophenolate mofetil. *Transplant Proc* 2008; 40(4): 953-5.
ii. Kobashigawa JA, Renlund DG, Gerosa G, et al. Similar efficacy and safety of enteric-coated mycophenolate sodium (EC-MPS, myfortic) compared with mycophenolate mofetil (MMF) in de novo heart transplant recipients: results of a 12-month, single-blind, randomized, parallel-group, multicenter study. *J Heart Lung Transplant* 2006; 25(8): 935-41.

c. Add pancreas transplant rejection, prophylaxis
i. Belliere J, Esposito L, Gandia P, et al. Comparison of the exposure of mycophenolate mofetil and enteric-coated mycophenolate sodium in recipients of kidney-pancreas transplantation. *Ann Transplant* 2014; 19: 76-81.
ii. Ricart MJ, Oppenheimer F, Andrés A, et al. Enteric-coated mycophenolate sodium in de novo and maintenance kidney-pancreas transplant recipients. *Clin Transplant* 2012;26(3):424-31.
iii. Rangel EB, Melaragno CS, Sá JR, et al. Mycophenolate mofetil versus enteric-coated mycophenolate sodium after simultaneous pancreas-kidney transplantation *Transplant Proc* 2009 Dec;41(10):4265-9.

d. Add vascular composite allograft rejection, prophylaxis
i. Tasigiorgos S, Kollar B, Turk M, et al. Five year follow-up after face transplantation. *N Engl J Med* 2019; 380:2579-2581.
ii. Diaz-Siso JR, Fischer S, Sisk GC, et al. Initial experience of dual maintenance immunosuppression with steroid withdrawal in vascular composite tissue allotransplantation. Am J Transplant 2015;15(5):1421-31.

5. Azathioprine

a. Add liver transplant rejection, prophylaxis
i. Germani G, Pleguezuelo M, Villamil F, et al. Azathioprine in liver transplantation: a reevaluation of its use and a comparison with mycophenolate mofetil. *Am J Transplant* 2009; 9(8): 1725-31.
ii. Samonakis DN, Triantos CK, Thalheimer U, et al. Immunosuppression and donor age with respect to severity of HCV recurrence after liver transplantation. *Liver Transpl* 2005; 11: 386–95.
iii. Wiesner R, Rabkin J, Klintmalm G, et al. A randomized double-blind comparative study of mycophenolate mofetil and azathioprine in combination with cyclosporine and corticosteroids in primary liver transplant recipients. *Liver Transplantation* 2001; 7(5): 442-50.

b. Add heart transplant rejection, prophylaxis
i. Keogh A, Macdonald P, Mundy J, et al. Five-year follow-up of a randomized double-drug versus triple-drug therapy immunosuppressive trial after heart transplantation. *J Heart Lung Transplant* 1992; 11(3 Pt 1): 550-5.
ii. Esmore DS, Spratt PM, Keogh AM, et al. Cyclosporine and azathioprine immunosuppression without maintenance steroids: a prospective randomized trial. *J Heart Transplant* 1989; 8(3): 194-9.
iii. Barnhart GR, Goldman MH, Hastillo A, et al. Comparison of immunosuppression therapy following heart transplantation:

pretransfusion/azathioprine/ATG/prednisone versus cyclosporine/prednisone. *J Heart Transplant* 1985; 4: 381-4.

c. Add lung transplant rejection, prophylaxis
    i. Bhorade S, Ahya VN, Baz MA, et al. Comparison of sirolimus with azathioprine in a tacrolimus-based immunosuppressive regimen in lung transplantation. *Am J Respir Crit Care Med* 2011; 183: 379-87.
    ii. McNeil K, Glanville AR, Wahlers T, et al. Comparison of mycophenolate mofetil and azathioprine for prevention of bronchiolitis obliterans syndrome in de novo lung transplant recipients. *Transplantation* 2006; 81: 998-1003.
    iii. Palmer SM, Baz MA, Sanders L, et al. Results of a randomized, prospective, multicenter trial of mycophenolate mofetil versus azathioprine in the prevention of acute lung allograft rejection. *Transplantation* 2001; 71: 1772-6.

d. Add pancreas transplant rejection, prophylaxis
    i. Merion RM, Mitchell H, Melzer J, et al. Randomized trial of mycophenolate mofetil versus azathioprine for prevention of acute renal allograft rejection after simultaneous pancreas kidney transplantation. *Transplantation* 2000; 70(1): 10-11.
    ii. Sutherland DE, Moudry KC, Fryd DS. Results of Pancreas Transplant Registry. *Diabetes* 1989; 38(S1): 46-54.

e. Add intestine transplant rejection, prophylaxis
    i. Abu-Elmagd KM, Costa G, Bond GJ, et al. Five hundred intestinal and multivisceral transplantations at a single center: major advances with new challenges. *Ann Surg* 2009; 250(4): 567-81.

f. Add vascular composite allograft rejection, prophylaxis
    i. Johannesson L, Testa G, Putman JM, et al. Twelve live births after uterus transplantation in the Dallas UtErus transplant study. *Obstet Gynecol 2021*;137(2):241-249.
    ii. Brännström M, Johannesson L, Bokström H, et al. Livebirth after uterus transplantation. *Lancet* 2015;385(9968):607-616.

6. Sirolimus

a. Add liver transplant rejection, prophylaxis
    i. Geissler EK, Schnitzbauer AA, Zulke C. Sirolimus use in liver transplant recipients with hepatocellular carcinoma: a randomized, multicenter, open-label phase 3 trial. *Transplantation* 2016; 100(1): 116-25.
    ii. Schnitzbauer AA, Sothmann J, Baier L, et al. Calcineurin inhibitor free de novo immunosuppression in liver transplant recipients with pretransplant renal impairment: results of a pilot study (PATRON07). *Transplantation* 2015; 99(12): 2565-75.
    iii. Teperman L, Moonka D, Sebastian A, et al. Calcineurin inhibitor-free mycophenolate mofetil/sirolimus maintenance in liver transplantation: the randomized spare-the-nephron trial. *Liver Transpl* 2013; 19(7): 675-89.
    iv. Watson CJ, Gimson AE, Alexander GJ, et al. A randomized controlled trial of late conversion from calcineurin inhibitor (CNI)-based to sirolimus-

based immunosuppression in liver transplant recipients with impaired renal function. *Liver Transpl* 2007; 13(12): 1694-702.
v. Chang GJ, Mahanty HD, Quan D, et al. Experience with the use of sirolimus in liver transplantation – use in patients for whom calcineurin inhibitors are contraindicated. *Liver Transpl* 2000; 6(6): 734-40.

b. Add heart transplant rejection, prophylaxis
i. Guethoff S, Stroeh K, Grinninger C, et al. De novo sirolimus with low-dose tacrolimus versus full-dose tacrolimus with mycophenolate mofetil after heart transplantation--8-year results. *J Heart Lung Transplant* 2015; 34(5): 634-42.
ii. Kaczmarek I, Zaruba MM, Beiras-Fernandez A, et al. Tacrolimus with mycophenolate mofetil or sirolimus compared with calcineurin inhibitor-free immunosuppression (sirolimus/mycophenolate mofetil) after heart transplantation: 5-year results. *J Heart Lung Transplant* 2013; 32(3): 277-84.
iii. Zuckermann A, Keogh A, Crespo-Leiro MG, et al. Randomized controlled trial of sirolimus conversion in cardiac transplant recipients with renal insufficiency. *Am J Transplant* 2012; 12(9): 2487-97.
iv. Meiser B, Buchholz S, Kaczmarek I. De-novo calcineurin-inhibitor-free immunosuppression with sirolimus and mycophenolate mofetil after heart transplantation: 5-year results. *Curr Opin Organ Transplant* 2011; 16(5): 522-8.
v. Groetzner J, Kaczmarek I, Schulz U, et al. Mycophenolate and sirolimus as calcineurin inhibitor-free immunosuppression improves renal function better than calcineurin inhibitor-reduction in late cardiac transplant recipients with chronic renal failure. *Transplantation* 2009; 87(5): 726-33.
vi. Kobashigawa JA, Miller LW, Russell SD, et al. Tacrolimus with mycophenolate mofetil (MMF) or sirolimus vs. cyclosporine with MMF in cardiac transplant patients: 1-year report. *Am J Transplant* 2006; 6(6): 1377-86.
vii. Mancini D, Pinney S, Burkhoff D, et al. Use of rapamycin slows progression of cardiac transplantation vasculopathy. *Circulation* 2003; 108(1): 48-53.

c. Add lung transplant rejection, prophylaxis
i. Sacher VY, Fertel D, Srivastana, et al. Effects of prophylactic use of sirolimus on bronchiolitis obliterans syndrome development in lung transplant recipients. Ann Thorac Surg 2014;97(1):268-74.
ii. Bhorade S, Ahya VN, Baz MA, et al. Comparison of sirolimus with azathioprine in a tacrolimus-based immunosuppressive regimen in lung transplantation. Am J Respir Crit Care Med 2011; 183(3): 379-87.

d. Add pancreas transplant rejection, prophylaxis
i. Ciancio G, Sageshima J, Chen L, et al. Advantage of rapamycin over mycophenolate mofetil when used with tacrolimus for simultaneous pancreas kidney transplants: randomized, single-center trial at 10 years. *Am J Transplant* 2012; 12(12): 3363-76.
ii. Knight RJ, Podder H, Kerman RH, et al. Comparing an early corticosteroid/late calcineurin-free immunosuppression protocol to a sirolimus-, cyclosporine A-, and prednisone-based regimen for pancreas-kidney transplantation. *Transplantation* 2010; 89(6): 727-32.

iii. Girman P, Lipar K, Koznarova R, et al. Similar early complication rate in simultaneous pancreas and kidney recipients on tacrolimus/ mycophenolate mofetil versus tacrolimus/sirolimus immunosuppressive regimens. *Transplant Proc* 2010; 42(6): 1999–2002.
iv. Rajab A, Pelletier RP, Ferguson RM, et al. Steroid-free maintenance immunosuppression with rapamune and low-dose neoral in pancreas transplant recipients. *Transplantation* 2007; 84(9): 1131-7.
v. Burke G, Ciancio G, Figueiro J, et al. Can acute rejection be prevented in SPK transplantation? *Transpl Proc* 2002; 34(5): 1913-4.

e. Add intestine transplant rejection, prophylaxis
   i. Abu-Elmagd KM, Costa G, Bond GJ, et al. Five hundred intestinal and multivisceral transplantations at a single center: major advances with new challenges. *Ann Surg* 2009; 250(4): 567-81.
   ii. Lauro A, Dazzi A, Ercolani G, et al. Rejection episodes and 3-year graft survival under sirolimus and tacrolimus treatment after adult intestinal transplantation. *Transplant Proc* 2007; 39(5): 1629-31.
   iii. Fishbein TM, Florman S, Gondolesi G, et al. Intestinal transplantation before and after the introduction of sirolimus. *Transplantation* 2002; 73(10): 1538-42.

f. Add vascular composite allograft rejection, prophylaxis
   i. Kaufman CL, Ouseph R, Blair B, et al. Graft vasculopathy in clinical hand transplantation. *Am J Transplant* 2012;12(4):1004-16.
   ii. Petruzzo P, Kanitakis J, Badet L, et al. Long-term follow-up incomposite tissue allotransplantation: in-depth study of five (hand and face) recipients. *Am J Transplant* 2011; 11: 808-16.
   iii. Brandacher G, Ninkovic M, Piza-Katzer H, et al. The Innsbruck hand transplant program: update at 8 years after the first transplant. *Transplant Proc* 2009;41(2):491-4.

7. Everolimus

a. Add heart transplant rejection, prophylaxis
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   ii. Gullestad L, Eiskjaer H, Gustafsson F, et al. Long-term outcomes of thoracic transplant recipients following conversion to everolimus with reduced calcineurin inhibitor in a multicenter, open-label, randomized trial. *Transpl Int* 2016; 29(7): 819-29.
   iii. Andreassen AK, Andersson B, Gustafsson F, et al. Everolimus initiation with early calcineurin inhibitor withdrawal in de novo heart transplant recipients: three-year results from the randomized SCHEDULE study. *Am J Transplant* 2016; 16(4): 1238-47.
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b. Add lung transplant rejection, prophylaxis
i. Gullestad L, Eiskjaer H, Gustafsson F, et al. Long-term outcomes of thoracic transplant recipients following conversion to everolimus with reduced calcineurin inhibitor in a multicenter, open-label, randomized trial. *Transpl Int* 2016; 29: 819-29.
ii. Glanville AR, Aboyoun C, Klepetko W, et al. Three-year results of an investigator-driven multicenter, international, randomized open-label de novo trial to prevent BOS after lung transplantation. *J Heart Lung Transplant* 2015; 34: 16-25.
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c. Add pancreas transplant rejection, prophylaxis
i. Li J, Koch M, Kramer K, et al. Dual antibody induction and de novo use of everolimus enable low-dose tacrolimus with early corticosteroid withdrawal in simultaneous pancreas-kidney transplantation. *Transpl Immunol* 2018; 50: 226-33.
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iii. di Francesco F, Cautero N, Vincenzi P, et al. One year follow-up of steroid-free immunosuppression plus everolimus in isolated pancreas transplantation. *Transplantation* 2008; 86(8): 1146-7.

d. Add vascular composite allograft rejection, prophylaxis
    i. Johannesson L, Testa G, Putman JM, et al. Twelve live births after uterus transplantation in the Dallas UtErus transplant study. *Obstet Gynecol* 2021;137(2):241-249.
    ii. Brandacher G, Ninkovic M, Piza-Katzer H, et al. The Innsbruck hand transplant program: update at 8 years after the first transplant. *Transplant Proc* 2009;41(2):491-4.

8. Belatacept

a. Add liver transplant rejection, prophylaxis
    i. LaMattina JC, Jason MP, Hanish SI, et al. Safety of belatacept bridging immunosuppression in hepatitis C-positive liver transplant recipients with renal dysfunction. *Transplantation* 2014; 97(2): 133-7.

b. Add heart transplant rejection, prophylaxis
    i. Launay M, Guitard J, Dorent R, et al. Belatacept-based immunosuppression: A calcineurin inhibitor-sparing regimen in heart transplant recipients. *Am J Transplant* 2020;20(2):553-563.
    ii. Enderby CY, Habib P, Patel PC, et al. Belatacept maintenance in a heart transplant recipient. *Transplantation* 2014; 98(7): 74-5.

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    i. Iasella CJ, Winstead RJ, Moore CA, et al. Maintenance belatacept-based immunosuppression in lung transplantation recipients who failed calcineurin inhibitors. *Transplantation* 2018; 102(1): 171-7.
    ii. Timofte I, Terrin M, Barr E, et al. Belatacept for renal rescue in lung transplant patients. *Transpl Int* 2016; 29(4): 453-63.

d. Add pancreas transplant rejection, prophylaxis
    i. Mujtaba MA, Sharfuddin AA, Taber T, et al. Conversion from tacrolimus to belatacept to prevent the progression of chronic kidney disease in pancreas transplantation: case report of two patients. *Am J Transplant* 2014; 14(11): 2657-61.

e. Add vascular composite allograft rejection, prophylaxis
    i. Cendales LC, Ruch DS, Cardones AR, et al. De novo belatacept in clinical vascularized composite allotransplantation. *Am J Transplant* 2018;18(7):1804-1809.
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f. Add heart transplant, pre-transplant desensitization

i. Alishetti S, Farr M, Jennings D, et al. Desensitizing highly sensitized heart transplant candidates with the combination of belatacept and proteasome inhibition. *Am J Transplant* 2020; 20(12): 3620-3630.

9. Basiliximab

    a. Add liver transplant rejection, prophylaxis
        i. Schmeding M, Sauer IM, Kiessling A, et al. Influence of basiliximab induction therapy on long term outcome after liver transplantation, a prospectively randomised trial. *Ann Transplant* 2007; 12: 15-21.
        ii. Neuhaus P, Clavien PA, Kittur D, et al. Improved treatment response with basiliximab immunoprophylaxis after liver transplantation: Results from a double-blind randomized placebo-controlled trial. *Liver Transpl* 2002; 8: 132-42.

    b. Add heart transplant rejection, prophylaxis
        i. Cantarovich M, Giannetti N, Routy JP, et al. Long-term immunosuppression with anti-CD25 monoclonal antibodies in heart transplant patients with chronic kidney disease. *J Heart Lung Transplant* 2009; 28(9): 912-8.
        ii. Cantarovich M, Metrakos P, Giannetti N, et al. Anti-CD25 monoclonal antibody coverage allows for calcineurin inhibitor "holiday" in solid organ transplant patients with acute renal dysfunction. *Transplantation* 2002; 73(7): 1169-72.

    c. Add lung transplant rejection, prophylaxis
        i. Borro JM, De la Torre M, Miguelez C, et al. Comparative study of basiliximab treatment in lung transplantation. *Transplant Proc* 2005; 37(9): 3996-8.

    d. Add pancreas transplant rejection, prophylaxis
        i. Fernández-Burgos I, Montiel Casado MC, Pérez-Daga JA, et al. Induction therapy in simultaneous pancreas-kidney transplantation: thymoglobulin versus basiliximab. *Transplant Proc* 2015; 47(1): 120-2.

    e. Add intestine transplant rejection, prophylaxis
        i. Kubal CA, Mangus RS, Vianna RM, et al. Impact of positive flow cytometry crossmatch on outcomes of intestinal/multivisceral transplantation: role anti-IL-2 receptor antibody. *Transplantation* 2013; 95(9): 1160-6.

    f. Add vascular composite allograft rejection, prophylaxis
        i. Kaufman CL, Ouseph R, Blair B, et al. Graft vasculopathy in clinical hand transplantation. *Am J Transplant* 2012;12(4):1004-16.
        ii. Jones JW, Gruber SA, Barker JH, et al. Successful hand transplantation: one year follow-up. *N Engl J Med* 2000;343:468-73.

10. Rabbit antithymocyte globulin

    a. Add liver transplant rejection, prophylaxis
        i. Montenovo MI, Jalikis FG, Li M, et al. Superior patient and graft survival in adult liver transplant with rabbit antithymocyte globulin induction: experience with 595 patients. *Exp Clin Transplant* 2017; 15(4): 425-31.

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b. Add heart transplant rejection, prophylaxis
    i. Aliabadi AZ, Grommer M, Dunkler et al. Impact of rabbit antithymocyte globulin dose on long-term outcomes in heart transplant patients. *Transplantation* 2016; 100(3): 685-93.
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    iv. Emin A, Rogers CA, Thekkudan J, et al. Antithymocyte globulin induction therapy for adult heart transplantation: a UK national study. *J Heart Lung Transplant*. 2011; 30(7): 770-7.
    v. Higgins R, Kirklin JK, Brown RN, et al. To induce or not to induce: do patients at greatest risk for fatal rejection benefit from cytolytic induction therapy? J Heart Lung Transplant 2005; 24: 392.

c. Add lung transplant rejection, prophylaxis
    i. Mullen JC, Oreopoulos A, Lien DC, et al. A randomized, controlled trial of daclizumab vs anti-thymocyte globulin induction for lung transplantation. *J Heart Lung Transplant* 2007;26(5):504-10.
    ii. Palmer SM, Miralles AP, Lawrence CM, et al. Rabbit antithymocyte globulin decreases acute rejection after lung transplantation: results of a randomized, prospective study. *Chest* 1999;116(1):127-33.

d. Add pancreas transplant rejection, prophylaxis
    i. B. Fernandez-Burgos I, Montiel Casado MC, Perez-Daga JA, et al. Induction therapy in simultaneous pancreas-kidney transplantation: thymoglobulin versus basiliximab. *Transplant Proc* 2015; 47(1): 120-2.
    ii. Bazerbachi F, Selzner M, Boehnert MU, et al. Thymoglobulin versus basiliximab induction therapy for simultaneous kidney pancreas transplantation: impact on rejection, graft function, and long-term outcome. *Transplantation* 2011; 92(9): 1039-43.
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e. Add intestine transplant rejection, prophylaxis
    i. Abu-Elmagd KM, Costa G, Bond GJ, et al. Five hundred intestinal and multivisceral transplantations at a single center: major advances with new challenges. *Ann Surg* 2009; 250(4): 567-81.

ii. Vianna RM, Mangus RS, Fridell JA, et al. Induction immunosuppression with thymoglobulin and rituximab in intestinal and multivisceral transplantation. *Transplantation* 2008; 85(9): 1290-3.
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f. Add vascular composite allograft rejection, prophylaxis
i. Johannesson L, Testa G, Putman JM, et al. Twelve live births after uterus transplantation in the Dallas UtErus transplant study. *Obstet Gynecol* 2021;137(2):241-249.
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vi. Brandacher G, Ninkovic M, Piza-Katzer H, et al. The Innsbruck hand transplant program: update at 8 years after the first transplant. *Transplant Proc* 2009;41(2):491-4.
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g. Add liver transplant rejection, treatment
i. Palmer WC, Taner CB, Keaveny AP, et al. Antithymocyte globulin use for corticosteroid nonresponsive rejection after liver transplantation. *Transplant Proc* 2018; 50(10): 3606-14.
ii. Kozlowski T, Rubinas T, Nickeleit V, et al. Liver allograft antibody-mediated rejection with demonstration of sinusoidal C4d staining and circulating donor-specific antibodies. *Liver Transpl* 2011; 17(4): 357-68.
iii. Wilson CH, Agarwal K, Carter V, et al. Late humoral rejection in a compliant ABO-compatible liver transplant recipient. *Transplantation* 2006; 82(7): 988-9.

h. Add heart transplant rejection, treatment
i. Costanzo M, Dipchand A, Starling R, et al. The International Society of Heart and Lung Transplantation guidelines for the care of heart transplant recipients. *J Heart Lung Transplant* 2010; 29: 914-56.

i. Add lung transplant rejection

i. January SE, Fester KA, Bain KB, et al. Rabbit antithymocyte globulin for the treatment of chronic lung allograft dysfunction. *Clin Transplant* 2019; 33(10): e13708.
ii. Izhakian S, Wasser WG, Fox BD, et al. Effectiveness of Rabbit Antithymocyte Globulin in Chronic Lung Allograft Dysfunction. *Transplant Proc* 2016; 48(6): 2152-6.

j. Add pancreas transplant rejection, treatment
i. Review of the diagnosis and treatment of pancreas rejection. Rejection treatment algorithm from the University of Wisconsin. D. Salahuddin S, Astor B, Parajuli S, et al. (2016). Outcomes with steroids alone for biopsy-proven pancreas transplant rejection. 2016 ATC Abstract. Retrieved from http://atcmeetingabstracts.com/abstract/outcomes-with-steroids-alone-for-biopsy-proven-pancreastransplant-rejection/
ii. Redfield RR, Kaufman DB, Odorico JS. Diagnosis and Treatment of Pancreas Rejection. *Curr Transplant Rep* 2015; 2(2): 169-75.

k. Add vascular composite allograft rejection, treatment
i. Tasigiorgos S, Kollar B, Turk M, et al. Five year follow-up after face transplantation. *N Engl J Med* 2019; 380:2579-2581.

11. Alemtuzumab

a. Add kidney transplant rejection, prophylaxis
i. Haynes R, Harden P, Judge P, et al. Alemtuzumab-based induction treatment versus basiliximab-based induction treatment in kidney transplantation (the 3C Study): a randomised trial. *Lancet* 2014; 384(9955): 1684-90.
ii. Hanaway MJ, Woodle S, Mulgaonkar S, et al. Alemtuzumab induction in renal transplantation. *N Engl J Med* 2011; 364(20): 1909-19.
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b. Add heart transplant rejection, prophylaxis
i. Gale SE, Ravichandran B, Ton VK, et al. Alemtuzumab Induction Versus Conventional Immunosuppression in Heart Transplant Recipients. *J Cardiovasc Pharmacol Ther* 2019;24(5):435-441.
ii. Teuteberg JJ, Shullo MA, Zomak R, et al. Alemtuzumab induction prior to cardiac transplantation with lower intensity maintenance immunosuppression: one-year outcomes. *Am J Transplant* 2010;10(2):382-8.

c. Add lung transplant rejection, prophylaxis
i. Benazzo A, Schwarz S, Muckenhuber M, et al. Alemtuzumab induction combined with reduced maintenance immunosuppression is associated with improved outcomes after lung transplantation: A single centre experience. *PLoS One* 2019; 14(1): e0210443.
ii. Jaksch P, Ankersmit J, Scheed A, et al. Alemtuzumab in lung transplantation: an open-label, randomized, prospective single center study. *Am J Transplant* 2014; 14(8): 1839-45.

d. Add pancreas transplant rejection, prophylaxis
    i. Stratta RJ, Rogers J, Orlando G, et al. Depleting antibody induction in simultaneous pancreas-kidney transplantation: a prospective single-center comparison of alemtuzumab versus rabbit anti-thymocyte globulin. *Expert Opin Biol Ther* 2014; 14(12): 1723-30.
    ii. Farney AC, Doares W, Rogers J, et al. A randomized trial of alemtuzumab versus antithymocyte globulin induction in renal and pancreas transplantation. *Transplantation* 2009; 88(6): 810-9.

e. Add intestine transplant rejection, prophylaxis
    i. Lauro A, Zanfi C, Bagni A, et al. Induction therapy in adult intestinal transplantation: reduced incidence of rejection with “2-dose” alemtuzumab protocol. *Clin Transplant* 2013; 27(4): 567-70.
    ii. Zanfi C, Lauro C, Cescon M, et al. Daclizumab and alemtuzumab as induction agents in adult intestinal and multivisceral transplantation: rejection and infection rates in 40 recipients during the early postoperative period. *Transplant Proc* 2010; 42(1): 35-8.
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f. Add vascular composite allograft rejection, prophylaxis
    i. Schneeberger S, Gorantla VS, Brandacher G, et al. Upper-extremity transplantation using a cell-based protocol to minimize immunosuppression. *Ann Surg* 2013; 257: 345-51.
    ii. Kaufman CL, Ouseph R, Blair B, et al. Graft vasculopathy in clinical hand transplantation. *Am J Transplant* 2012;12(4):1004-16.
    iii. Brandacher G, Ninkovic M, Piza-Katzer H, et al. The Innsbruck hand transplant program: update at 8 years after the first transplant. *Transplant Proc* 2009;41(2):491-4.

g. Add kidney transplant rejection, treatment
    i. van den Hoogen MW, Hesselink DA, van Son WJ, et al. Treatment of steroid-resistant acute renal allograft rejection with alemtuzumab. *Am J Transplant* 2013; 13(1): 192-6.
    ii. Ciancio G, Burke GW. Alemtuzumab (Campath-1H) in kidney transplantation. *Am J Transplant* 2008; 8: 15-20.

h. Add lung transplant rejection, treatment
    i. Moniodis A, Townsend K, Rabin A, et al. Comparison of extracorporeal photopheresis and alemtuzumab for the treatment of chronic lung allograft dysfunction. *J Heart Lung Transplant* 2018; 37(3): 340-8.
    ii. Ensor CR, Rihtarchik LC, Morrell MR, et al. Rescue alemtuzumab for refractory acute cellular rejection and bronchiolitis obliterans syndrome after lung transplantation. *Clin Transp*. 2017; 31: e12899.
    iii. Reams BD, Musselwhite LW, Zaas DW, et al. Alemtuzumab in the treatment of refractory acute rejection and bronchiolitis obliterans syndrome after human lung transplantation. *Am J Transplant* 2007; 7: 2802-8.

i. Add vascular composite allograft rejection, treatment
    i. Tasigiorgos S, Kollar B, Turk M, et al. Five year follow-up after face transplantation. *N Engl J Med* 2019; 380:2579-2581.

ii. Petruzzo P, Kanitakis J, Testelin S, et al. Clinicopathological findings of chronic rejection in a face grafted patient. *Transplantation* 2015; 99(12): 2644-50.
iii. Chandraker A, Arscott R, Murphy GF, et al. The management of antibody-mediated rejection in the first presensitized recipient of a full-face allotransplant. *Am J Transplant* 2014;14(6):1446-52.

12. Immune globulin

a. Add kidney transplant rejection, treatment
    i. Cooper JE, Gralla J, Klem P, et al. High dose intravenous immunoglobulin therapy for donor-specific antibodies in kidney transplant recipients with acute and chronic graft dysfunction. *Transplantation* 2014; 97(12): 1253-9.
    ii. Lefaucheur C, Nochy D, Andrade J, et al. Comparison of combination plasmapheresis/IVIg/anti-CD20 versus high-dose IVIg in the treatment of antibody-mediated rejection.*Am J Transplant* 2009; 9(5): 1099-107.
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b. Add liver transplant rejection, treatment
    i. Kozlowski T, Rubinas T, Nickeleit V, et al. Liver allograft antibody-mediated rejection with demonstration of sinusoidal C4d staining and circulating donor-specific antibodies. *Liver Transpl* 2011; 17(4): 357-68.
    ii. Urbani L, Mazzoni A, De Simone P, et al. Treatment of antibody-mediated rejection with high-dose immunoglobulins in ABO-incompatible liver transplant recipient. *Transpl Int* 2007; 20(5): 467-70.
    iii. Wilson CH, Agarwal K, Carter V, et al. Late humoral rejection in a compliant ABO-compatible liver transplant recipient. *Transplantation* 2006; 82(7): 988-9.

c. Add heart transplant rejection, treatment
    i. Kaczorowski DJ, Datta J, Kamoun M, Dries DL, Woo YJ. Profound hyperacute cardiac allograft rejection rescue with biventricular mechanical circulatory support and plasmapheresis, intravenous immunoglobulin, and rituximab therapy*. J Cardiothorac Surg* 2013; 16(8):48.
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d. Add lung transplant rejection, treatment
    i. Neuhaus K, Hohlfelder B, Bollinger J, et al. Antibody-Mediated Rejection Management Following Lung Transplantation. *Ann Pharmacother* 2021 Apr 26:10600280211012410.
    ii. Muller YD, Aubert JD, Vionnet J, et al. Acute antibody-mediated rejection 1 week after lung transplantation successfully treated with eculizumab, intravenous immunoglobulins, and rituximab. *Transplantation* 2018; 102(6): e301-3.
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   i. Hartono C, Kim J, McDermott J, et al. High-dose intravenous immunoglobulin (IVIG) adjuvant therapy for cell-mediated pancreas transplant rejection. *Transplantation* 2013; 96(5): e43-4.
   ii. Melcher ML, Olson JL, Baster-Lowe LA, et al. Antibody-mediated rejection of a pancreas allograft. *Am J Transplant* 2006; 6(2): 432-8.

f. Add intestine transplant rejection, treatment
   i. Wu GS, Zhao QC, Li ZS, et al. Successful rescue of late-onset antibody-mediated rejection 12 years after living-donor intestinal transplantation. *Transplant Proc* 2017; 49(1): 232-6.

g. Add vascular composite allograft rejection, treatment
   i. Tasigiorgos S, Kollar B, Turk M, et al. Five year follow-up after face transplantation. *N Engl J Med* 2019; 380:2579-2581.
   ii. Chandraker A, Arscott R, Murphy GF, et al. The management of antibody-mediated rejection in the first presensitized recipient of a full-face allotransplant. *Am J Transplant* 2014;14(6):1446-52.

h. Add kidney transplant, pre-transplant desensitization
   i. Vo AA, Choi J, Cisneros K, et al. Benefits of rituximab combined with intravenous immunoglobulin for desensitization in kidney transplant recipients. *Transplantation* 2014; 98(3): 312-9.
   ii. Vo AA, Petrozzino J, Yeung K, et al. Efficacy, outcomes, and cost-effectiveness of desensitization using IVIG and rituximab. *Transplantation* 2013; 95(6): 852-8.
   iii. Vo AA, Lukovsky M, Toyoda M, et al. Rituximab and intravenous immune globulin for desensitization during renal transplantation. *N Engl J Med* 2008; 359: 242-51.
   iv. Stegall MD, Gloor J, Winters JL, et al. A comparison of plasmapheresis versus high-dose IVIG desensitization in renal allograft recipients with high levels of donor specific alloantibody. *Am J Transplant* 2006; 6(2): 346-51.
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i. Add liver transplant, pre-transplant desensitization
    i. Kim SH, Lee EC, Shim JR, et al. A simplified protocol using rituximab and immunoglobulin for ABO-incompatible low-titre living donor liver transplantation. *Liver Int* 2018; 38(5) :932-9.
    ii. Kim JD, Choi DL, Kim SG, et al. Single-center experience of ABO-incompatible living-donor liver transplantation with a new simplified intravenous immunoglobulin protocol: A propensity score-matching analysis. *Transplant Proc* 2016; 48(4): 1134-8.

j. Add heart transplant, pre-transplant desensitization
    i. Kobashigawa JA, Patel JK, Kittleson MM, et al. The long-term outcome of treated sensitized patients who undergo heart transplantation. *Clin Transplant* 2011; 25(1): E61-7.
    ii. Pisani BA, Mullen GM, Malinowska K, et al. Plasmapheresis with intravenous immunoglobulin G is effective in patients with elevated panel reactive antibody prior to cardiac transplantation*. J Heart Lung Transplant* 1999; 18(7): 701-6.
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13. Rituximab

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    i. Sautenet B, Blancho G, Buchler M, et al. One-year results of the effects of rituximab on acute antibody-mediated rejection in renal transplantation: RITUX ERAH, a multicenter double-blind randomized placebo-controlled trial. *Transplantation* 2016; 100(2): 391-9.
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    i. Melcher ML, Olson JL, Baster-Lowe LA, et al. Antibody-mediated rejection of a pancreas allograft. *Am J Transplant* 2006; 6(2): 432-8.

g. Add intestine transplant rejection, treatment
    i. Wu GS, Zhao QC, Li ZS, et al. Successful rescue of late-onset antibody-mediated rejection 12 years after living-donor intestinal transplantation. *Transplant Proc* 2017; 49(1): 232-6.

h. Add vascular composite allograft rejection, treatment
    i. Tasigiorgos S, Kollar B, Turk M, et al. Five year follow-up after face transplantation. *N Engl J Med* 2019; 380:2579-2581.
    ii. Weissenbacher A, Hautz T, Zelger B, et al. Antibody-mediated rejection in hand transplantation. *Transpl Int* 2014;27(2):e13-7.

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14. Bortezomib

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    i. Govil A, Walsh RC, Tevar A, et al. Bortezomib-based treatment of antibody mediated rejection in pancreas allograft recipients. *Clin Transpl* 2009; 443-53.

f. Add intestine transplant rejection, treatment
    i. Fujiwara S, Wada M, Kudo H, et al. Effectiveness of bortezomib in a patient with acute rejection associated with an elevation of donor-specific HLA antibodies after small-bowel transplantation: case report. *Transplant Proc* 2016; 48(2): 522-7.
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    i. Tasigiorgos S, Kollar B, Turk M, et al. Five year follow-up after face transplantation. *N Engl J Med* 2019; 380:2579-2581.
    ii. Chandraker A, Arscott R, Murphy GF, et al. The management of antibody-mediated rejection in the first presensitized recipient of a full-face allotransplant. *Am J Transplant* 2014;14(6):1446-52.

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15. Carfilzomib

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b. Add kidney transplant, pre-transplant desensitization
    i. Tremblay S, Driscoll JJ, Rike-Shields A, et al. A prospective, iterative, adaptive trial of carfilzomib-based desensitization. *Am J Transplant* 2020; 20(2): 411-421.

c. Add heart transplant, pre-transplant desensitization
    i. Sriwattanakomen R, Xu Q, Demehin M, et al. Impact of carfilzomib-based desensitization on heart transplantation of sensitized candidates. J Heart Lung Transplant. 2021; 40(7): 595-603.
    ii. Alishetti S, Farr M, Jennings D, et al. Desensitizing highly sensitized heart transplant candidates with the combination of belatacept and proteasome inhibition. Am J Transplant 2020; 20(12): 3620-3630.

16. Eculizumab

a. Add heart transplant rejection, prophylaxis
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b. Add kidney transplant rejection, treatment
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e. Add lung transplant rejection, treatment
    i. Muller YD, Aubert JD, Vionnet J, et al. Acute antibody-mediated rejection 1 week after lung transplantation successfully treated with eculizumab, intravenous immunoglobulins, and rituximab. *Transplantation* 2018; 102(6): e301-3.
    ii. Dawson KL, Parulekar A, Seethamraju H. Treatment of hyperacute antibody-mediated lung allograft rejection with eculizumab. *J Heart Lung Transplant* 2012; 31(12): 1325-6.

f. Add pancreas transplant rejection, treatment
    i. Bilgarnia AR, Nilsson B, Nilsson T, et al. Prompt reversal of a severe complement activation by eculizumab in a patient undergoing intentional ABO-incompatible pancreas and kidney transplantation. *Transplant Int* 2011; 24(8): e61-6.

g. Add intestine transplant rejection, treatment
    i. Fan J, Tryphonopoulos P, Tekin A, et al. Eculizumab salvage therapy for antibody-mediated rejection in a desensitization-resistant intestinal re-transplant patient. *Am J Transplant* 2015; 15(7): 1995-2000.

h. Add vascular composite allograft rejection, treatment
    i. Tasigiorgos S, Kollar B, Turk M, et al. Five year follow-up after face transplantation. *N Engl J Med* 2019; 380:2579-2581.
    ii. Chandraker A, Arscott R, Murphy GF, et al. The management of antibody-mediated rejection in the first presensitized recipient of a full-face allotransplant. *Am J Transplant* 2014;14(6):1446-52.

i. Add kidney transplant, pre-transplant desensitization
    i. Marks WH, Mamode N, Montgomery R, et al. Safety and efficacy of eculizumab in the prevention of antibody-mediated rejection in living-donor kidney transplant recipients requiring desensitization therapy. *Am J Transplant* 2019; 19(10): 2876-2888.

17. Tocilizumab

a. Add kidney transplant rejection, treatment
    i. Shin BH, Everly MJ, Zhang H, et al. Impact of Tocilizumab (Anti-IL-6R) Treatment on Immunoglobulins and Anti-HLA Antibodies in Kidney Transplant Patients With Chronic Antibody-mediated Rejection. *Transplantation* 2020; 104(4): 856-863.
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b. Add kidney transplant, pre-transplant desensitization

i. Vo AA, Choi J, Kim I, et al. A phase I/II trial of the interleukin-6 receptor-specific humanized monoclonal (tocilizumab) + intravenous immunoglobulin in difficult to desensitize patients. *Transplantation* 2015; 99(11): 2356-63.

18. Adalimumab

a. Add intestine transplant rejection, treatment

i. Rao B, Jafri SM, Kazimi M, et al. A case report of acute cellular rejection following intestinal transplantation managed with adalimumab. *Transplant Proc* 2016; 48(2): 536-8.

19. Infliximab

a. Add intestine transplant rejection, treatment

i. Kroemer A, Belyayev L, Khan K, et al. Rejection of intestinal allotransplants is driven by memory T helper type 17 immunity and responds to infliximab. *Am J Transplant* 2021; 21(3): 1238-1254.

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