

# Transplant Resources, Patient Education and Transplant Study End Points

Amanda J. Condon Martinez, Pharm.D., BCTXP, BCPS  
Clinical Pharmacist, Value Based Care  
Kidneylink  
Plano, TX



1



## Disclosures

- I have no financial relationships or conflicts of interest to disclose.

2

# Transplant Resources



3

## Learning Objectives

- List key government organizations and transplant societies that influence the practice of solid organ transplantation.
- Compare practice-defining guidelines within the field of solid organ transplantation.

4

## Outline

- Influencers of the practice of organ transplantation
- Transplant societies & organizations
- Transplant guidelines used in organ transplantation

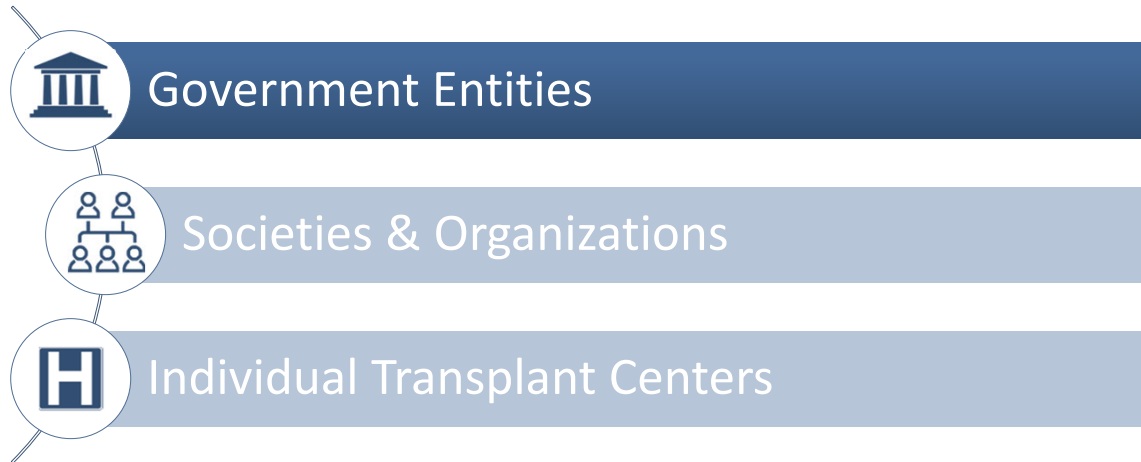
5

## Influencers of Practice



6

## Influencers of Practice



7

## Influencers of Practice – Government Entities

- Organ transplant is a highly regulated field of medicine
- Government oversight implemented to ensure patient safety and effective use of organs

**Centers for Medicare  
and Medicaid  
Services (CMS)**

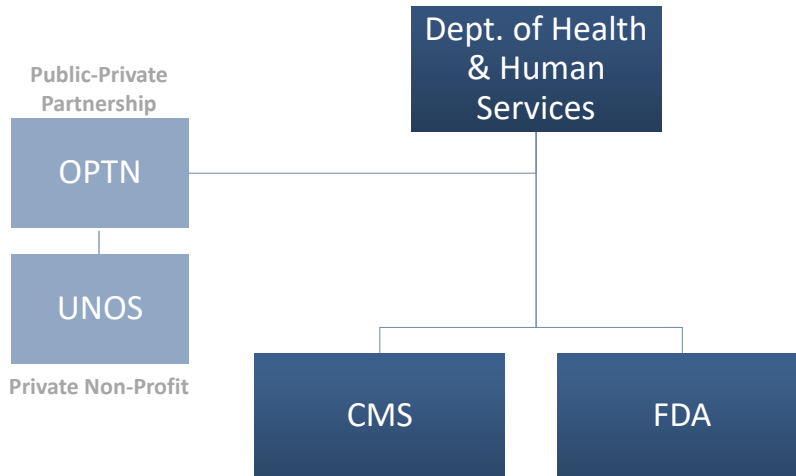
**Organ Procurement  
and Transplantation  
Network (OPTN)**

**Food & Drug  
Administration  
(FDA)**

**United Network for  
Organ Sharing (UNOS)**

8

## Influencers of Practice – Government Entities



U.S. Department of Health & Human Services. <https://www.hhs.gov/about/agencies/index.html>. Accessed January 20, 2020.

9

## Influencers of Practice – Government Entities

### Centers for Medicare & Medicaid

Established Conditions of Practice (CoPs) for transplant programs to participate in Medicare

Provides quality and safety oversight for participating hospitals

Collects data from OPTN/UNOS to evaluate compliance to CoPs

Performs onsite evaluations to ensure compliance to CoPs

Medicare Program: Hospital conditions of participation: requirements for approval and reapproval of transplant centers to perform organ transplants (42 CFR 405.482, 488, 498). Federal Register. March 30, 2007;72:15198-15280.

10

## Influencers of Practice – Government Entities

### Organ Procurement & Transplantation Network

Creates policies that govern operation of hospitals, organ procurement organizations, and histocompatibility laboratories

Establishes membership requirements for organizations to participate in U.S. transplant network

Evaluates each organization via the OPTN Contractor (UNOS)

Reports program findings to CMS

Organ Procurement & Transplantation Network. <https://optn.transplant.hrsa.gov>. Accessed January 20, 2020.

11

## Influencers of Practice – Government Entities

### United Network for Organ Sharing

Manages national transplant waiting list

Maintains database that contains all organ transplant data for every transplant event in the U.S.

Monitor every organ allocation to ensure policy compliance

Perform site surveys of participating organizations

United Network for Organ Sharing. <https://unos.org>. Accessed January 20, 2020.

12

## Influencers of Practice – Government Entities

### Food & Drug Administration

Ensures safety and effectiveness of all transplant medications, biologics, and medical devices

Determines appropriateness of clinical trial endpoints for investigational drugs

Collaborates with private, non-profit organizations to accelerate medical product development

Provides guidance on areas of need within transplantation as related to clinical trial design

U.S. Food & Drug Administration. <https://www.fda.gov>. Accessed January 20, 2020.

13

## Influencers of Practice



Government Entities



Societies & Organizations



Individual Transplant Centers

14

## Influencers of Practice – Societies/Organizations

- Impact practice by:

### EDUCATION

Developing  
Guidelines

Journals

Online Learning

### ADVOCACY

Influence Gov.  
Policy

Author Consensus  
Statements

Create Accreditation  
Standards for  
Training

### NETWORKING

Unite Practitioners

Host Meetings

Lusters

15

## Transplant Societies & Organizations

- Many organizations exist that promote the field of organ transplantation
- Utility to transplant professionals:
  - Guidelines
  - Policy Development
  - Networking
  - Education
  - Patient Engagement

16



## Transplant Societies & Organizations

Organization	Organs Referenced	Guideline Sponsorship	Patient Education Materials	Affiliated Journal
American Society of Transplantation (AST)	All	Yes	Yes	American Journal of Transplantation  Clinical Transplantation
American Society of Transplant Surgeons (ASTS)	All	Yes	Yes	American Journal of Transplantation  Clinical Transplantation

 = Transplant Pharmacist Professional Group

17

## Transplant Societies & Organizations

Organization	Organs Referenced	Guideline Sponsorship	Patient Education Materials	Affiliated Journal
International Society for Heart and Lung Transplantation (ISHLT)	Heart Lung	Yes	Yes	Journal of Heart and Lung Transplantation
The Transplantation Society (TTS)	All	Yes	No	Transplantation
International Pediatric Transplant Association (IPTA)	All	Yes	No	Pediatric Transplantation

18

## Transplant Societies & Organizations

Organization	Organs Referenced	Guideline Sponsorship	Patient Education Materials	Affiliated Journal
American Society of Health-System Pharmacists (ASHP)	None	Yes	No	American Journal of Health-System Pharmacy
American College of Clinical Pharmacy (ACCP)	All	Yes	Yes	Pharmacotherapy  Journal of the American College of Clinical Pharmacy

19

## Transplant Societies & Organizations

Organization	Organs Referenced	Guideline Sponsorship	Patient Education Materials	Affiliated Journal
American Society of Nephrology (ASN)	Kidney	Yes	Yes	Journal of the American Society of Nephrology  Clinical Journal of the American Society of Nephrology

20

## Transplant Societies & Organizations

Organization	Organs Referenced	Guideline Sponsorship	Patient Education Materials	Affiliated Journal
National Kidney Foundation (NKF)	Kidney	Yes	Yes	American Journal of Kidney Disease
American Association for the Study of Liver Diseases (AASLD)	Liver	Yes		Hepatology Liver Transplantation
International Pancreas and Islet Transplant Association (IPITA)	Pancreas Islet Cell	No	No	None

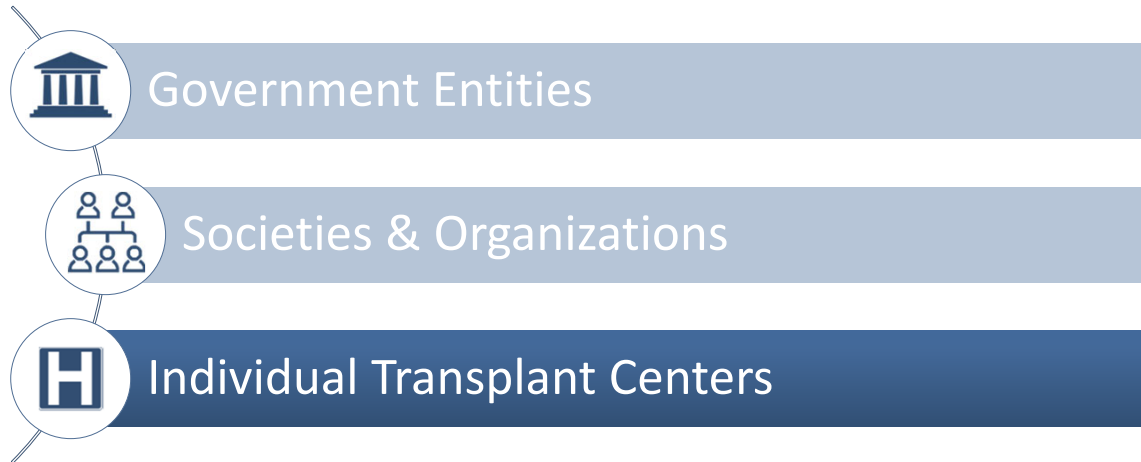
21

## Transplant Societies & Organizations

Organization	Organs Referenced	Guideline Sponsorship	Patient Education Materials	Affiliated Journal
Society for Pediatric Liver Transplantation (SPLIT)	Liver	No	No	None
Transplant Infectious Diseases (TID)	All	Yes	No	Transplant Infectious Diseases

22

## Influencers of Practice



23

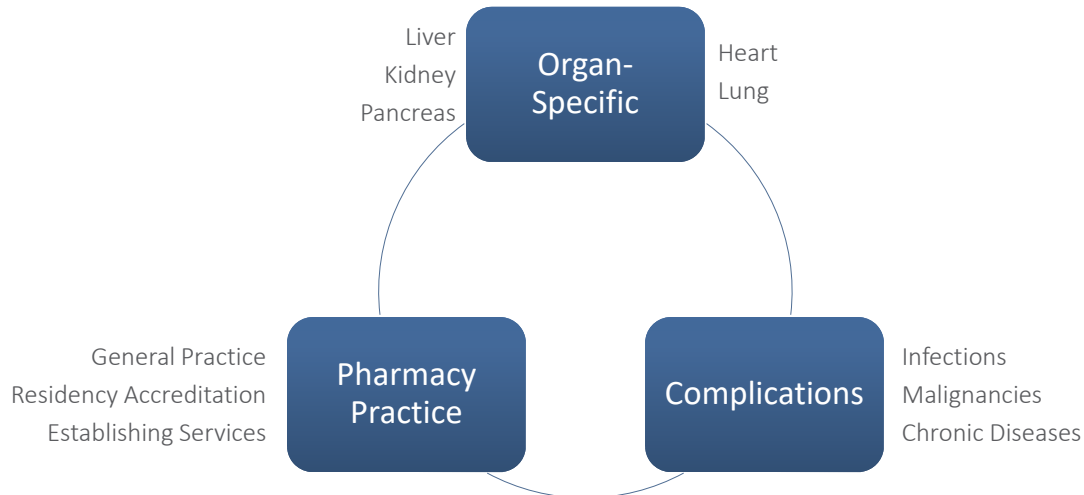
## Influencers of Practice – Individual Centers

- Impact practice by:



24

## Transplant Guidelines & Practice Standards



25

## Transplant Guidelines

### Organ-Specific Guidelines: Kidney

Guideline	Reference	Last Updated
<b>KDIGO Clinical Practice Guideline for the Care of Kidney Transplant Recipients</b>	Kidney Disease: Improving Global Outcomes (KDIGO) Transplant Work Group. KDIGO clinical practice guideline for the care of kidney transplant recipients. Am J Transplant. 2009 Nov;9 Suppl 3:S1-155.	2009
<b>KDOQI US Commentary on the 2009 KDIGO Clinical Practice Guideline for the Care of Kidney Transplant Recipients</b>	Bia M, Adey DB, Bloom RD et al. KDOQI US commentary on the 2009 KDIGO clinical practice guideline for the care of kidney transplant recipients. Am J Kidney Dis. 2010 Aug;56(2):189-218.	2010

26

## Transplant Guidelines

### Organ-Specific Guidelines: Kidney

Guideline	Reference	Last Updated
<b>Guidelines for Post-Kidney Transplant Management in the Community Setting</b>	American Society of Transplantation. 2009. Available at <a href="https://www.myast.org/guidelines-post-kidney-transplant-management-community-setting">https://www.myast.org/guidelines-post-kidney-transplant-management-community-setting</a> . Accessed January 21, 2020.	2009
<b>KDIGO Clinical Practice Guideline on the Evaluation and Care of Living Kidney Donors</b>	Lentine KL, Kasiske BL, Levey AS et al. KDIGO Clinical Practice Guideline on the Evaluation and Care of Living Kidney Donors. Transplantation. 2017 Aug;101(8S Suppl 1):S1-S109.	2017

27

## Transplant Guidelines

### Organ-Specific Guidelines: Liver

Guideline	Reference	Last Updated
<b>Evaluation for Liver Transplantation in Adults: 2013 Practice Guideline by the AASLD and the AST</b>	Martin P, DiMartini A, Feng S et al. Evaluation for liver transplantation in adults: 2013 practice guideline by the American Association for the Study of Liver Diseases and the American Society of Transplantation. Hepatology. 2014 Mar;59(3):1144-65.	2013
<b>Evaluation for Liver Transplantation in Pediatric Patients: Practice Guideline by the AASLD</b>	Squires RH, Ng V, Romero R et al. Evaluation of the pediatric patient for liver transplantation: 2014 practice guideline by the American Association for the Study of Liver Diseases, American Society of Transplantation and the North American Society for Pediatric Gastroenterology, Hepatology and Nutrition. Hepatology. 2014 Jul;60(1):362-98.	2014

28

## Transplant Guidelines

### Organ-Specific Guidelines: Liver

Guideline	Reference	Last Updated
<b>Long-term Management of the Successful Adult Liver Transplant: 2012 Practice Guidelines by the AASLD and the AST</b>	Lucey MR, Terrault N, Ojo L et al. Long-term management of the successful adult liver transplant: 2012 practice guideline by the American Association for the Study of Liver Diseases and the American Society of Transplantation. Liver Transpl. 2013 Jan;19(1):3-26.	2012
<b>Long-term Medical Management of the Pediatric Patient After Liver Transplantation: 2013 Practice Guideline by the AASLD and the AST</b>	Kelly DA, Bucuvalas JC, Alonso EM et al. Long-term medical management of the pediatric patient after liver transplantation: 2013 practice guideline by the American Association for the Study of Liver Diseases and the American Society of Transplantation. Liver Transpl. 2013 Aug;19(8):798-825.	2013

29

## Transplant Guidelines

### Organ-Specific Guidelines: Pancreas

Guideline	Reference	Last Updated
<b>Pancreas and Islet Transplantation in Type 1 Diabetes</b>	Robertson RP, Davis C, Larsen J et al; American Diabetes Association. Pancreas and islet transplantation in type 1 diabetes. Diabetes Care. 2006 Apr;29(4):935.	2006

30

## Transplant Guidelines

### Organ-Specific Guidelines: Heart

Guideline	Reference	Last Updated
<b>ISHLT Consensus Statement on Donor Organ Acceptability and Management in Pediatric Heart Transplantation</b>	Kirk R, Dipchand AI, Davies RR et al. ISHLT consensus statement on donor organ acceptability and management in pediatric heart transplantation. J Heart Lung Transplant. 2020 Jan;39(4):331-41.	2020
<b>The Management of Antibodies in Heart Transplantation: An ISHLT Consensus Document</b>	Kobashigawa J, Colvin M, Potena L et al. The management of antibodies in heart transplantation: An ISHLT consensus document. J Heart Lung Transplant. 2018 May;37(5):537-547.	2018
<b>The 2016 ISHLT Listing Criteria for Heart Transplantation: A 10-year Update</b>	Mehra MR, Canter CE, Hannan MM et al. The 2016 International Society for Heart Lung Transplantation listing criteria for heart transplantation: A 10-year update. J Heart Lung Transplant. 2016 Jan;35(1):1-23.	2016

31

## Transplant Guidelines

### Organ-Specific Guidelines: Heart

Guideline	Reference	Last Updated
<b>Antibody-mediated Rejection in Cardiac Transplantation: Emerging Knowledge in Diagnosis and Management</b>	Colvin MM, Cook JL, Chang P et al. Antibody-mediated rejection in cardiac transplantation: emerging knowledge in diagnosis and management: a scientific statement from the American Heart Association. Circulation. 2015 May 5;131(18):1608-39.	2015
<b>The ISHLT Guidelines for the Care of Heart Transplant Recipients</b>	Costanzo MR, 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 Aug;29(8):914-56.	2010

32



## Transplant Guidelines

### Organ-Specific Guidelines: Heart

Guideline	Reference	Last Updated
<b>Optimal Pharmacologic and Non-Pharmacologic Management of Cardiac Transplant Candidates</b>	Jessup M, Banner N, Brozena S et al. Optimal pharmacologic and non-pharmacologic management of cardiac transplant candidates: approaches to be considered prior to transplant evaluation: International Society for Heart and Lung Transplantation guidelines for the care of cardiac transplant candidates--2006. J Heart Lung Transplant. 2006 Sep;25(9):1003-23.	2006
<b>Heart Rhythm Considerations in Heart Transplant Candidates</b>	Gronda E, Bourge RC, Costanzo MR et al. Heart rhythm considerations in heart transplant candidates and considerations for ventricular assist devices: International Society for Heart and Lung Transplantation guidelines for the care of cardiac transplant candidates--2006. J Heart Lung Transplant. 2006 Sep;25(9):1043-56. Erratum in: J Heart Lung Transplant. 2006 Oct;25(10):1276.	2006

33

## Transplant Guidelines

### Organ-Specific Guidelines: Lung

Guideline	Reference	Last Updated
<b>A Consensus Document for the Selection of Lung Transplant Candidates: An Update from the International Society for Heart and Lung Transplantation</b>	Leard LE, Holm AM, Valapour M et al. Consensus documented for the selection of lung transplant candidates: An update from the International Society for Heart and Lung Transplantation. J Heart and Lung Transplant. 2021 July;40(11):1349-79.	2021
<b>International Society for Heart and Lung Transplantation Consensus Statement for the Standardization of Bronchoalveolar Lavage in Lung Transplantation</b>	Martini T, Koutsokera A, Benden C et al. International Society for Heart and Lung Transplantation consensus statement for the standardization of bronchoalveolar lavage in lung transplantation. J Heart and Lung Transplant. 2020 July;39(11):1171-90.	2020

34

## Transplant Guidelines

### Organ-Specific Guidelines: Lung

Guideline	Reference	Last Updated
<b>Donor Heart and Lung Procurement: A Consensus Statement</b>	Copeland H, Awori Hayanga JW, Neyrinck A et al. Donor heart and lung procurement: A consensus statement. J Heart and Lung Transplant. 2020 Apr;39(6):501-17.	2020
<b>Utilization of Hepatitis C Virus-Infected Organ Donors in Cardiothoracic Transplantation: An ISHLT Expert Consensus Statement</b>	Aslam S, Grossi P, Schlendorf KH et al. Utilization of hepatitis C virus-infected organ donors in cardiothoracic transplantation: An ISHLT expert consensus statement. J Heart and Lung Transplant. 2020 Mar;39(5):418-32.	2020

35

## Transplant Guidelines

### Organ-Specific Guidelines: Lung

Guideline	Reference	Last Updated
<b>Chronic Lung Allograft Dysfunction: Definition, Diagnostic Criteria, and Approaches to Treatment</b>	Verleden GM, Glanville AR, Lease ED et al. Chronic lung allograft dysfunction: Definition, diagnostic criteria, and approaches to treatment-A consensus report from the Pulmonary Council of the ISHLT. J Heart Lung Transplant. 2019 May;38(5):493-503.	2019
<b>Chronic Lung Allograft Dysfunction: Definition and Update of Restrictive Allograft Syndrome</b>	Glanville AR, Verleden GM, Todd JL et al. Chronic lung allograft dysfunction: Definition and update of restrictive allograft syndrome-A consensus report from the Pulmonary Council of the ISHLT. J Heart Lung Transplant. 2019 May;38(5):483-492.	2019

36

## Transplant Guidelines

### Organ-Specific Guidelines: Lung

Guideline	Reference	Last Updated
<b>Antibody-mediated Rejection of the Lung: A Consensus Report of the ISHLT</b>	Levine DJ, Glanville AR, Aboyoun C et al. Antibody-mediated rejection of the lung: A consensus report of the International Society for Heart and Lung Transplantation. J Heart Lung Transplant. 2016 Apr;35(4):397-406.	2016
<b>ISHLT Consensus Statement on Adult and Pediatric Airway Complications after Lung Transplantation: Definitions, Grading System, and Therapeutics</b>	Crespo MM, McCarthy DP, Hopkins PM et. ISHLT Consensus Statement on adult and pediatric airway complications after lung transplantation: Definitions, grading system, and therapeutics. J Heart Lung Transplant. 2018 May;37(5):548-563.	2018

37

## Transplant Guidelines

### Organ-Specific Guidelines: Lung

Guideline	Reference	Last Updated
<b>An International ISHLT/ATS/ERS Clinical Practice Guideline: Diagnosis and Management of Bronchiolitis Obliterans Syndrome</b>	Meyer KC, Raghu G, Verleden GM et al. An international ISHLT/ATS/ERS clinical practice guideline: diagnosis and management of bronchiolitis obliterans syndrome. Eur Respir J. 2014 Dec;44(6):1479-503.	2014

38

## Transplant Guidelines

### Complications: Infections

Guideline	Reference	Last Updated
<b>4<sup>th</sup> Edition of the AST Infectious Diseases Guidelines</b>	Green M, Blumberg EA, Danziger-Isakov L et al. Foreword: 4th edition of the American Society of Transplantation Infectious Diseases Guidelines. Clin Transplant. 2019 Sep;33(9):e13642.	2019
<b>Donor-derived Fungal Infections in Organ Transplant Recipients: Guidelines of the AST Infectious Diseases Community of Practice</b>	Singh N, Huprikar S, Burdette SD et al. Donor-derived fungal infections in organ transplant recipients: guidelines of the American Society of Transplantation, infectious diseases community of practice. Am J Transplant. 2012 Sep;12(9):2414-28.	2012

39

## Transplant Guidelines

### Complications: Infections

Guideline	Reference	Last Updated
<b>Guidance for Organ Donation and Transplantation Professionals Regarding the Zika Virus</b>	Organ Procurement & Transplantation Network. 2016. <a href="https://optn.transplant.hrsa.gov/news/guidance-for-organ-donation-and-transplantation-professionals-regarding-the-zika-virus/">https://optn.transplant.hrsa.gov/news/guidance-for-organ-donation-and-transplantation-professionals-regarding-the-zika-virus/</a> Accessed January 21, 2020.	2016
<b>The 2015 ISHLT Guidelines for the Management of Fungal Infections in Mechanical Circulatory Support and Cardiothoracic Organ Transplant Recipients</b>	Husain S, Sole A, Alexander BD et al. The 2015 International Society for Heart and Lung Transplantation Guidelines for the management of fungal infections in mechanical circulatory support and cardiothoracic organ transplant recipients: Executive summary. J Heart Lung Transplant. 2016 Mar;35(3):261-282.	2015

40

## Transplant Guidelines

### Complications: Infections

Guideline	Reference	Last Updated
<b>SARS-CoV-2 (Coronavirus, 2019-nCoV): Recommendations and Guidance for Organ Donor Testing</b>	American Society of Transplantation. 2021. Available at <a href="https://www.myast.org/recommendations-and-guidance-organ-donor-testing">https://www.myast.org/recommendations-and-guidance-organ-donor-testing</a> Accessed April 15, 2022.	2021
<b>Statement on Use of Monoclonal Antibody for Pre-Exposure Prophylaxis of SARS-CoV-2</b>	American Society of Transplantation. 2022. Available at <a href="https://www.myast.org/covid-19-information">https://www.myast.org/covid-19-information</a> Accessed April 15, 2022.	2022

41

## Transplant Guidelines

### Complications: Malignancies

Guideline	Reference	Last Updated
<b>Initial Skin Cancer Screening for Solid Organ Transplant Recipients in the United States</b>	Crow LD, Jambusaria-Pahlajani A, Chung CL et al. Initial skin cancer screening for solid organ transplant recipients in the United States: Delphi method development of expert consensus guidelines. Transpl Int. 2019 Dec;32(12):1268-1276.	2019
<b>Post-transplant Lymphoproliferative Disorders, Epstein-Barr Virus Infection, and Diseases in Solid Organ Transplantation: Guidelines of the AST Infectious Disease Community of Practice</b>	Allen UD, Preiksaitis JK. Post-transplant lymphoproliferative disorders, Epstein-Barr virus infection, and disease in solid organ transplantation: Guidelines from the American Society of Transplantation Infectious Diseases Community of Practice. Clin Transplant. 2019 Sep;33(9):e13652.	2019

42

## Transplant Guidelines

### Complications: Malignancies

Guideline	Reference	Last Updated
<b>National Comprehensive Cancer Network Post-Transplant Lymphoproliferative Disorders Guideline Version 5.2014.</b>	National Comprehensive Cancer Network. Available at: <a href="https://nccn.org">https://nccn.org</a> . Accessed January 21, 2020.	2014

43

## Transplant Guidelines

### Complications: Chronic Diseases

Guideline	Reference	Last Updated
<b>Cardiac Disease Evaluation and Management Among Kidney and Liver Transplantation Candidates from the AHA and ACCF</b>	Lentine KL, Costa SP, Weir MR et al. Cardiac disease evaluation and management among kidney and liver transplantation candidates: a scientific statement from the American Heart Association and the American College of Cardiology Foundation: endorsed by the American Society of Transplant Surgeons, American Society of Transplantation, and National Kidney Foundation. Circulation. 2012 Jul 31;126(5):617-63.	2012
<b>KDIGO Clinical Practice Guideline for Lipid Management in Chronic Kidney Disease</b>	Wanner C, Tonelli M. KDIGO Clinical Practice Guideline for Lipid Management in CKD: summary of recommendation statements and clinical approach to the patient. Kidney Int. 2014 Jun;85(6):1303-9.	2014

44

## Transplant Guidelines

### Complications: Chronic Diseases

Guideline	Reference	Last Updated
<b>KDIGO 2017 Clinical Practice Update for the Diagnosis, Evaluation, Prevention and Treatment of CKD-MBD</b>	Kidney Disease: Improving Global Outcomes (KDIGO) CKD-MBD Update Work Group. KDIGO 2017 Clinical Practice Guideline Update for the Diagnosis, Evaluation, Prevention, and Treatment of Chronic Kidney Disease-Mineral and Bone Disorder (CKD-MBD). <i>Kidney Int Suppl</i> (2011). 2017 Jul;7(1):1-59.	2017
<b>Primary Care of the Solid Organ Transplant Recipient from AAFP</b>	Cimino FM, Snyder KA. Primary Care of the Solid Organ Transplant Recipient. <i>Am Fam Physician</i> . 2016 Feb 1;93(3):203-10.	2016

45

## Transplant Guidelines

### Pharmacy Practice Guidelines & Position Statements

Guideline	Reference	Last Updated
<b>ASHP Guidelines on Pharmacy Services in Solid Organ Transplantation</b>	Maldonado AQ, Hall RC, Pilch NA et al. ASHP Guidelines on Pharmacy Services in Solid Organ Transplantation. <i>Am J Health Syst Pharm</i> . 2020 Jan 24;77(3):222-232.	2019
<b>Evolution of the Role of the Transplant Pharmacist on the Multidisciplinary Transplant Team</b>	Alloway RR, Dupuis R, Gabardi S et al; American Society of Transplantation Transplant Pharmacy Community of Practice and the American College of Clinical Pharmacy Immunology/Transplantation Practice and Research Network. Evolution of the role of the transplant pharmacist on the multidisciplinary transplant team. <i>Am J Transplant</i> . 2011 Aug;11(8):1576-83.	2011

46

## Transplant Guidelines

### Pharmacy Practice Guidelines & Position Statements

Guideline	Reference	Last Updated
<b>Value of Solid Organ Transplant-Trained Pharmacists in Transplant Infectious Diseases</b>	Trofe-Clark J, Kaiser T, Pilch N et al. Value of solid organ transplant-trained pharmacists in transplant infectious diseases. Curr Infect Dis Rep. 2015 Apr;17(4):475.	2015
<b>Required Competency Areas, Goals, and Objectives for PGY2 Solid Organ Transplant Pharmacy Residencies</b>	American Society of Health-System Pharmacists. <a href="https://www.ashp.org/Professional-Development/Residency-Information/Residency-Program-Directors/Residency-Accreditation/PGY2-Competency-Areas">https://www.ashp.org/Professional-Development/Residency-Information/Residency-Program-Directors/Residency-Accreditation/PGY2-Competency-Areas</a> Accessed January 21, 2020	2018
<b>Entrustable Professional Activities for Pharmacy Students: A Primer for Solid Organ Transplant Preceptors</b>	Lichvar A, Moss Chandran M, Do V et al. Am J Health Syst Pharm. 2021 Aug;zxab320.	2021

47

## Transplant Guidelines

### Pharmacy Practice Guidelines & Position Statements

Guideline	Reference	Last Updated
<b>Assessing Pharmacologic and Nonpharmacologic Risks in Candidates for Kidney Transplantation</b>	Maldonado AQ, Tichy EM, Rogers CC et al. Assessing pharmacologic and nonpharmacologic risks in candidates for kidney transplantation. Am J Health Syst Pharm. 2015 May 15;72(10):781-93.	2015
<b>Expanding Transplant Pharmacist Presence in Pretransplantation Ambulatory Care</b>	Maldonado AQ, Bowman LJ, Szempruch KR. Expanding transplant pharmacist presence in pretransplantation ambulatory care. Am J Health Syst Pharm. 2017 Jan 15;74(2):22-25.	2017
<b>Building a Business Plan to Support a Transplantation Pharmacy Model</b>	Tichy EM, Pilch NA, Smith LD et al. Building a business plan to support a transplantation pharmacy practice model. Am J Health Syst Pharm. 2014 May 1;71(9):751-7.	2014

48



**Question 1 (LO#1):** Which government organization is responsible for managing the U.S. transplant waiting list?

- a. The U.S. Food & Drug Administration
- b. The Centers for Medicare & Medicaid
- c. The United Network for Organ Sharing
- d. The Organ Procurement & Transplantation Network

Educate healthcare professionals, trainees, and other stakeholders concerning medication-related issues with the care of transplant patients.

Knowledge of:

- a. Pertinent literature, evidence-based treatment guidelines and consensus statements
- b. Publications by professional societies  
(e.g., American Society of Health-system Pharmacists, International Society for Heart and Lung Transplantation, American College of Clinical Pharmacy, American Society of Transplantation)

49

**Question 1 (LO#1):** Which government organization is responsible for managing the U.S. transplant waiting list?

- a. The U.S. Food & Drug Administration
- b. The Centers for Medicare & Medicaid
- c. The United Network for Organ Sharing**
- d. The Organ Procurement & Transplantation Network

Educate healthcare professionals, trainees, and other stakeholders concerning medication-related issues with the care of transplant patients.

Knowledge of:

- a. Pertinent literature, evidence-based treatment guidelines and consensus statements
- b. Publications by professional societies  
(e.g., American Society of Health-system Pharmacists, International Society for Heart and Lung Transplantation, American College of Clinical Pharmacy, American Society of Transplantation)

50



**Question 2 (LO#2):** Your organization would like to create a PGY2 in solid organ transplant. Which guideline would help structure the residency and serve as a best practices to obtain approval for the position?

- a. The ASHP Guideline on Pharmacy Services in Solid Organ Transplantation
- b. The ASHP Required Competency Areas Goals and Objectives for PGY2 Solid Organ Transplant Pharmacy Residencies
- c. Building a Business Plan to Support a Transplantation Pharmacy Model
- d. Evolution of the Role of the Transplant Pharmacist on the Multidisciplinary Transplant Team

Educate healthcare professionals, trainees, and other stakeholders concerning medication-related issues with the care of transplant patients.

Knowledge of:

- b. Publications by professional societies

(e.g., American Society of Health-system Pharmacists, International Society for Heart and Lung Transplantation, American College of Clinical Pharmacy, American Society of Transplantation)

- c. Principles and methods for educating pharmacist, trainees, and other healthcare professionals on transplantation-related issues

51



**Question 2 (LO#2):** Your organization would like to create a PGY2 in solid organ transplant. Which guideline would help structure the residency and serve as a best practices to obtain approval for the position?

- a. The ASHP Guideline on Pharmacy Services in Solid Organ Transplantation
- b. The ASHP Required Competency Areas Goals and Objectives for PGY2 Solid Organ Transplant Pharmacy Residencies**
- c. Building a Business Plan to Support a Transplantation Pharmacy Model
- d. Evolution of the Role of the Transplant Pharmacist on the Multidisciplinary Transplant Team

Educate healthcare professionals, trainees, and other stakeholders concerning medication-related issues with the care of transplant patients.

Knowledge of:

- b. Publications by professional societies

(e.g., American Society of Health-system Pharmacists, International Society for Heart and Lung Transplantation, American College of Clinical Pharmacy, American Society of Transplantation)

- c. Principles and methods for educating pharmacist, trainees, and other healthcare professionals on transplantation-related issues

52

## Key Takeaways

- Government organizations play a key role in influencing the practice of solid organ transplantation
- Many organizations and societies exist to facilitate engagement and networking within the profession of transplantation
- Transplantation is unique in that individual programs have the ability to significantly influence practice

53

## Patient Education

54

## Learning Objectives

- Assess patients' barriers to understanding their medication regimen and adapt education strategy to foster patient competency.
- Describe appropriate monitoring strategies for transplant medications requiring REMS participation.
- Formulate an appropriate contraceptive regimen for a female transplant recipient of childbearing age.
- Evaluate patient risk factors for non-adherence and implement a plan to improve compliance.

55

## Outline

- Patient-specific considerations
- Non-adherence
- Interviewing strategies
- Home monitoring
- Proper drug storage, handling, and disposal
- Risk Evaluation and Mitigation Strategies
- Pregnancy and contraception

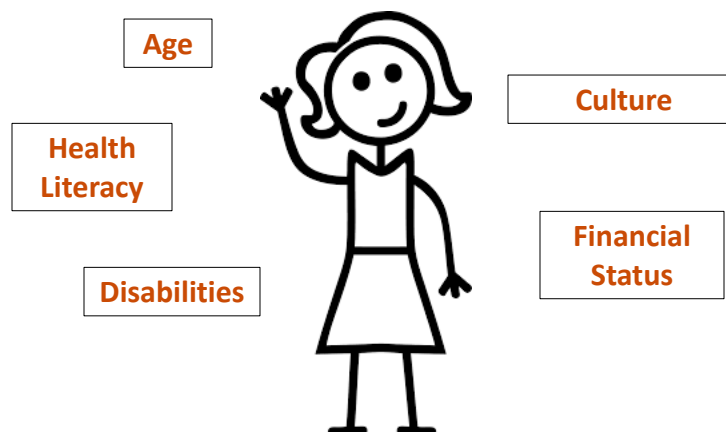
56

## Patient Considerations & Interviewing

Medication education should be tailored to the individual patient to ensure optimal medication use

57

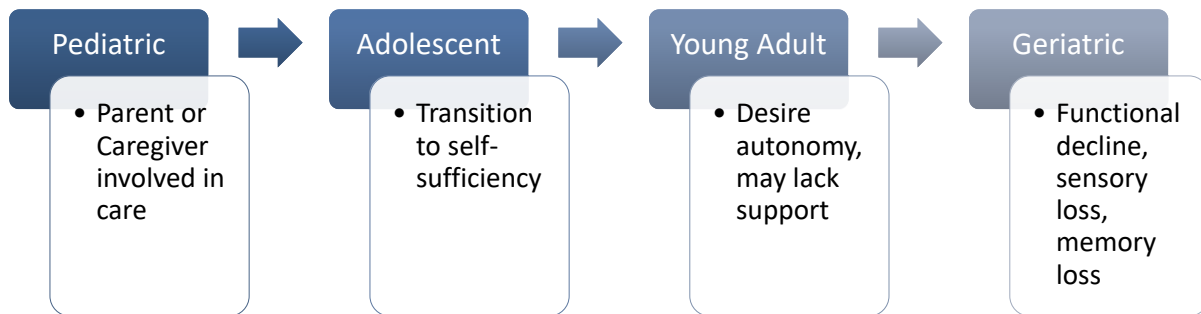
## Patient-Specific Considerations



Gast A, Mathes T. Medication adherence influencing factors - an (updated) overview of systematic reviews. Syst Rev. 2019 May 10;8(1):112.

58

## Patient-Specific Considerations – Age



59

## Patient-Specific Considerations – Health Literacy

Low health literacy is common in organ transplantation

- Ranges from 15%-72%<sup>1,2</sup>
- Influenced by geographic region and patient characteristics<sup>1</sup>

Low health literacy is associated with negative graft outcomes

- In kidney recipients, associated with increased serum creatinine<sup>3</sup>
- In liver recipients, high health literacy associated with fewer hospitalizations<sup>1</sup>
- More likely to be readmitted after transplant and experience graft loss<sup>4</sup>

<sup>1</sup>Chisholm MA, Fair J, Spivey CA. Health literacy and transplant patients and practitioners. Public Health. 2007 Oct;121(10):800-3.

<sup>2</sup>Serper M, Patzer RE, Reese PP et al. Medication misuse, nonadherence and clinical outcomes among liver transplant recipients. Liver Transpl. 2015 Jan;21(1):22-8.

<sup>3</sup>Gordon EJ, Wolf MS. Health literacy skills of kidney transplant recipients. Prog Transplant. 2009 Mar;19(1):25-34.

<sup>4</sup>Miller-Matero LR, Bryce K, Hyde-Nolan ME et al. Health literacy status affects outcomes for patients referred for transplant. Psychosomatics. 2016 Sep;57(5):522-8.

60

## Patient-Specific Considerations – Health Literacy

### Low health literacy is impacted by

- Older Age
- Minority Race/Ethnicity
- Non-Native English Speaker
- Socioeconomic Factors
- Health Insurance Status
- Deceased donor
- Increased Comorbidities
- Negative Health Beliefs/Attitudes
- Limited Verbal Ability
- Limited Cognitive Function
- Increased Vision/Hearing Impairment

Chisholm MA, Spivey CA, Pickett LR. Health literacy in solid-organ transplantation: a model to improve understanding. Patient Prefer Adherence. 2018;12:2325-38.

61

## Patient-Specific Considerations – Cultural

### Cultural beliefs and values are highly specific

- Will vary based on composition of transplant center's patient population
- May be different from person-to-person within a cultural group

### Cultural beliefs can impact

- Beliefs in how health care should be delivered and received
- Beliefs in the type and level of care a patient wishes to receive
- Beliefs in how the patient is viewed within their family/community (familism vs. individualism)

Singleton K, Krause EMS. Understanding cultural and linguistic barriers to health literacy. Online J Issues Nurs. 2009;14(3). Manuscript 4.

62

## Patient-Specific Considerations – Disabilities

### Disabilities (cognitive, visual, auditory) may impact patient understanding

- Reports of 40-70% of transplant candidates may exhibit cognitive dysfunction<sup>1,2</sup>
- Visual and auditory impairment can negatively impact patient outcomes<sup>3</sup>

### Cognitive assessments may help identify impairment and disability

- Patients may not be forthcoming with cognitive, visual, or auditory impairments
- Transplant pharmacists should tailor medication education to improve understanding for these individuals

<sup>1</sup>Burker BS, Gude E, Gullestad L et al. Cognitive function among long-term survivors of heart transplantation. Clin Transplant. 2017;31(12):e13143.

<sup>2</sup>Cohen DG, Christie JD, Anderson BJ et al. Cognitive function, mental health and health-related quality of life after lung transplantation. Ann Am Thorac Soc. 2014;11(4):522-30.

<sup>3</sup>Speros CI. More than words: promoting health literacy in older adults. Online J Issues Nurs. 2009;14(3): Manuscript 5.

63

## Patient-Specific Considerations – Finances

### Financial insecurity negatively impacts transplant recipients

- Lower household income is associated with a lower transplant rate and graft survival<sup>1,2</sup>
- Low socioeconomic status is associated with non-adherence<sup>3</sup>

### Insurance type can impact patient's ability to afford medication

- Insurance policy determines co-payment/co-insurance
- Low socioeconomic status patients may end up uninsured after transplant and unable to afford care

<sup>1</sup>Goldfarb-Rumyantzev AS, Koford JK, Baird BC et al. Role of socioeconomic status in kidney transplant outcome. Clin J Am Soc Nephrol. 2006 Mar;1(2):313-22.

<sup>2</sup>Mohan S, Mutell R, Patzer RE et al. Kidney transplantation and the intensity of poverty in the contiguous United States. Transplantation. 2014 Sep 27;98(6): 640-45.

<sup>3</sup>Wayda B, Clemons A, Givens RC. Socioeconomic disparities in adherence and outcomes after heart transplant. Circ Heart Fail. 2018 Mar;11(3):e004173.

64



## Patient-Specific Considerations

### Strategies to Improve Understanding for Patients



#### Pictures/Visual Aids

- Use small words
- Use images to describe medication use
- Tools may be available at pharmacy



#### Recordings

- Use recording device to record medication education
- Create education that is accessible from internet



#### Engage Caregiver

- Patient family/caregivers should receive medication education
- Determine learning style that works for patient and caregiver



#### Address Finances

- Refer to financial coordinator
- Familiarize self with coupons and patient assistance programs

65

## Nonadherence

### Nonadherence is common after transplantation

- Affects approximately 28-52% of organ recipients<sup>1</sup>
- Younger age, unmarried, and low social support have been identified as contributors to nonadherence<sup>1</sup>
- Pediatric patients transitioning to adults are high risk for nonadherence

### Nonadherence increases risk for poor post-transplant outcomes

- Odds of graft failure can be up to 7 times higher due to nonadherence<sup>2</sup>
- In study of liver recipients, 10% died due to nonadherence<sup>3</sup>

<sup>1</sup>Denhaerynck K, Dobbels F, Cleemput I et al. Prevalence, consequences, and determinants of nonadherence in adult renal transplant patients: a literature review. *Transpl Int.* 2005;18:1121-33.

<sup>2</sup>Butler JA, Roderick P, Mullee M et al. Frequency and impact of nonadherence to immunosuppression after renal transplantation: a systematic review. *Transplantation.* 2004;77:769-76.

<sup>3</sup>O'Carroll RE, McGregor LM, Swanson V et al. Adherence to medication after liver transplantation in Scotland: a pilot study. *Liver Transpl.* 2006;12:1862-68.

66

## Nonadherence

### Risk factors for nonadherence in solid organ transplantation

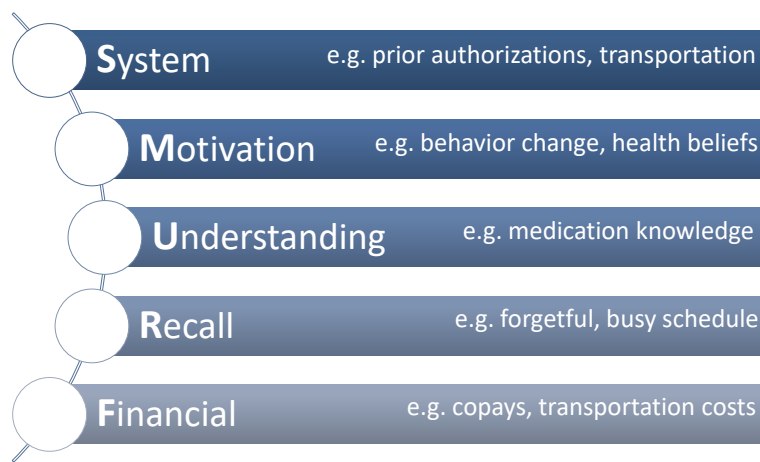
- Young age (<25 years)
- Male gender
- Non-white
- Increasing post-transplant time
- Low self-efficacy
- High self-reported nonadherence
- More frequent dosing
- Rural environment
- Public insurance
- Having a graft from a living-related donor
- Patient beliefs

Doyle IC, Maldonado AQ, Heldenbrand S et al. Nonadherence to therapy after adult solid organ transplantation. Am J Health Syst Pharm. 2016 Jun 15;73(12):909-20.  
 Denhaerynck K, Steiger J, Bock A et al. Prevalence and risk factors of non-adherence with immunosuppressive medication in kidney transplant patients. Am J Transplant. 2007 Jan;7(1):108-16

67

## Nonadherence

### Modifiable Barriers to Adherence:



Pharmacists can easily identify these barriers and implement strategies to improve adherence

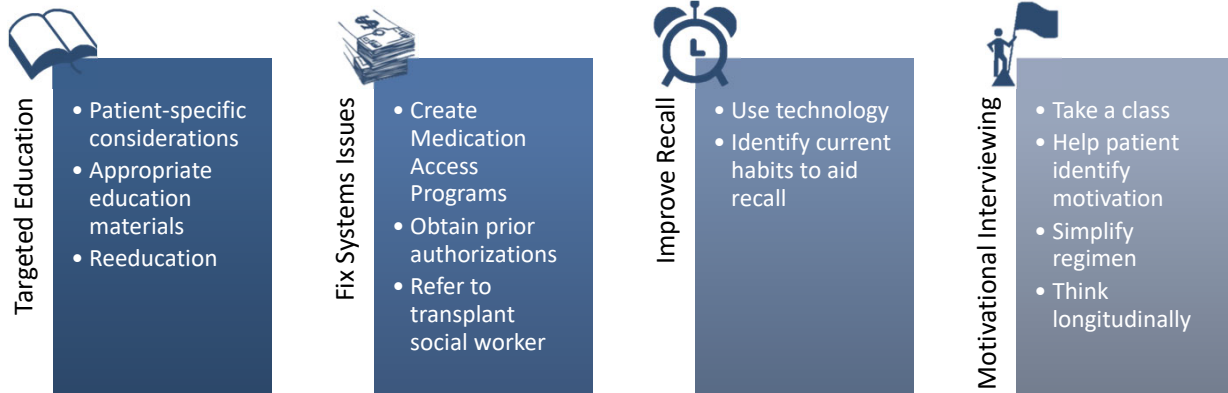
Able to incorporate into the entire transplant interprofessional team

Adapted from: "Adherence: it's more than just about taking meds". Pharmacy Society of Wisconsin Adherence Competence Collaborative. <http://www.pswi.org/> Accessed January 29, 2020

68

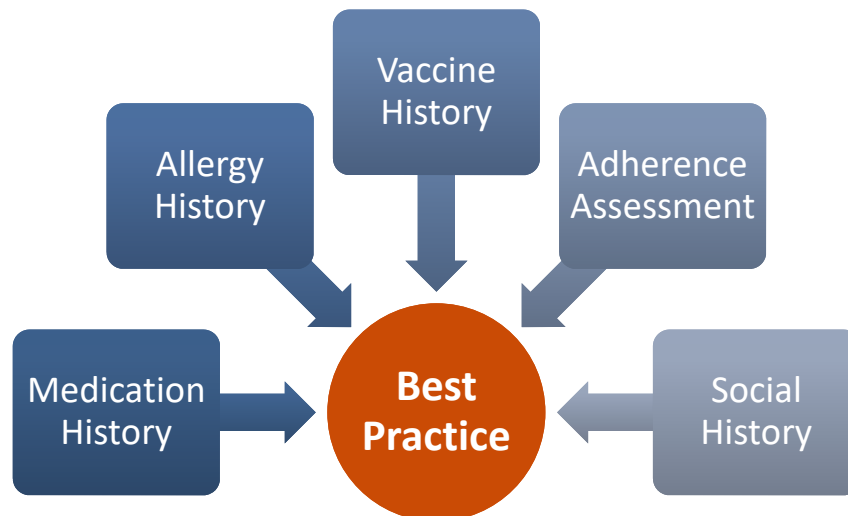
## Nonadherence

### Strategies to Improve Adherence



69

## Interviewing Strategies



70

## Interviewing Strategies

### Medication History:

Tools	Includes	Transplant Specific
<input type="checkbox"/> Patient Bottles	<input type="checkbox"/> Prescriptions	<input type="checkbox"/> Immunosuppression Regimen
<input type="checkbox"/> Pharmacy Fill History	<input type="checkbox"/> OTC/Vitamins	<input type="checkbox"/> Therapeutic Goals
<input type="checkbox"/> Insurance Claims	<input type="checkbox"/> Herbal Supplements	<input type="checkbox"/> Reason for Off-Protocol Medications
<input type="checkbox"/> Facility Records	<input type="checkbox"/> Injectables & Devices	<input type="checkbox"/> Infectious Complications
<input type="checkbox"/> Medication Visual Descriptions	<input type="checkbox"/> Illicit Substances	
	<input type="checkbox"/> Discontinued Medications (and why)	
	<input type="checkbox"/> Last Dose	


71

## Interviewing Strategies

### Allergy History:

Tools	Includes	Transplant Specific
<input type="checkbox"/> Patient/Caregiver	<input type="checkbox"/> Drug & Reaction	<input type="checkbox"/> Suboptimal Antimicrobial Use
<input type="checkbox"/> Facility Records	<input type="checkbox"/> Timing	<input type="checkbox"/> Risk of Untrue Allergies
<input type="checkbox"/> Allergist Consult	<input type="checkbox"/> Treatment	<input type="checkbox"/> Consideration for Desensitization
	<input type="checkbox"/> Time to Resolution	
	<input type="checkbox"/> Retrial	
	<input type="checkbox"/> Similar Agent Tolerated	
	<input type="checkbox"/> Removal of Untrue Allergy	

72




## Interviewing Strategies

### Vaccine History:

Tools	Includes	Transplant Specific
<div style="background-color: #2C4E64; height: 20px; width: 100%; position: relative; margin-bottom: 10px;"> <div style="background-color: white; width: 5%; height: 100%; position: absolute; left: 0;"></div> </div> <div style="display: flex; flex-direction: column; gap: 10px;"> <div><input type="checkbox"/> Patient Records</div> <div><input type="checkbox"/> Facility Records</div> <div><input type="checkbox"/> State Records</div> </div>	<div style="background-color: #2C4E64; height: 20px; width: 100%; position: relative; margin-bottom: 10px;"> <div style="background-color: white; width: 5%; height: 100%; position: absolute; left: 0;"></div> </div> <div style="display: flex; flex-direction: column; gap: 10px;"> <div><input type="checkbox"/> Vaccine Administered</div> <div><input type="checkbox"/> Date of Administration</div> <div><input type="checkbox"/> Titers (if indicated)</div> <div><input type="checkbox"/> Reason for Refusal</div> </div>	<div style="background-color: #2C4E64; height: 20px; width: 100%; position: relative; margin-bottom: 10px;"> <div style="background-color: white; width: 5%; height: 100%; position: absolute; left: 0;"></div> </div> <div style="display: flex; flex-direction: column; gap: 10px;"> <div><input type="checkbox"/> Avoid Live Vaccines Post-Transplant</div> <div><input type="checkbox"/> If Unsure History, Vaccinate</div> </div>

73



## Interviewing Strategies

### Adherence Assessment:

Tools	Includes	Transplant Specific
<div style="background-color: #2C4E64; height: 20px; width: 100%; position: relative; margin-bottom: 10px;"> <div style="background-color: white; width: 5%; height: 100%; position: absolute; left: 0;"></div> </div> <div style="display: flex; flex-direction: column; gap: 10px;"> <div><input type="checkbox"/> Pharmacy Fill History</div> <div><input type="checkbox"/> Pill Counting</div> <div><input type="checkbox"/> Interviewing Skills</div> </div>	<div style="background-color: #2C4E64; height: 20px; width: 100%; position: relative; margin-bottom: 10px;"> <div style="background-color: white; width: 5%; height: 100%; position: absolute; left: 0;"></div> </div> <div style="display: flex; flex-direction: column; gap: 10px;"> <div><input type="checkbox"/> Drugs Involved</div> <div><input type="checkbox"/> Reason(s)</div> <div><input type="checkbox"/> Action Plan</div> </div>	<div style="background-color: #2C4E64; height: 20px; width: 100%; position: relative; margin-bottom: 10px;"> <div style="background-color: white; width: 5%; height: 100%; position: absolute; left: 0;"></div> </div> <div style="display: flex; flex-direction: column; gap: 10px;"> <div><input type="checkbox"/> Risks of Non-Adherence</div> <div><input type="checkbox"/> Transplant Support Groups</div> </div>

74



## Drug Storage, Handling & Disposal

Specific storage, handling and disposal information can be found in a medication package insert

77

## Drug Storage

### Medications Should Be:

Stored in a cool, dry place to maintain integrity unless otherwise specified by package insert (e.g., not in medicine cabinet)

- Medications such as insulin, liquid formulations, and inhalers may have different storage recommendations

Secure and out of reach of pets and children to avoid accidental ingestion

Discarded if damaged or expired

78

## Drug Handling

Some immunosuppression and antimicrobial prophylaxis are considered hazardous substances

Hazardous drugs have special handling instructions established by the National Institute for Occupational Safety and Health (NIOSH)

NIOSH recommendations do not pertain to patients

"NIOSH list of antineoplastic and other hazardous drugs in healthcare settings, 2016". National Institute for Occupational Safety and Health. [www.cdc.gov](http://www.cdc.gov) . Accessed January 28, 2020.

79

## Drug Handling

### NIOSH Hazardous Drugs Commonly Used in Transplantation

<b>Table 1</b> <i>Antineoplastics Meet 1 or More NIOSH Criteria</i>	<b>Table 2</b> <i>Non-Antineoplastics Meet 1 or More NIOSH Criteria</i>	<b>Table 3</b> <i>Non-Antineoplastics Primarily Reproductive Hazard</i>
<ul style="list-style-type: none"> <li>• Bortezomib</li> <li>• Everolimus</li> </ul>	<ul style="list-style-type: none"> <li>• Azathioprine</li> <li>• Cidofovir</li> <li>• Entecavir</li> <li>• Ganciclovir</li> <li>• Leflunomide</li> <li>• Mycophenolate</li> <li>• Sirolimus</li> <li>• Tacrolimus</li> <li>• Valganciclovir</li> </ul>	<ul style="list-style-type: none"> <li>• Fluconazole</li> <li>• Voriconazole</li> </ul>
<b>Table 5 provides guidance on appropriate personal protective equipment use</b>		

"NIOSH list of antineoplastic and other hazardous drugs in healthcare settings, 2016". National Institute for Occupational Safety and Health. [www.cdc.gov](http://www.cdc.gov) . Accessed January 28, 2020.

80



## Drug Disposal

The best way to dispose of a medication is to drop it off at a drug take back program or site

The medication patient guide contains information on disposal if a special disposal process is required

If a take back program is not available, mix the medication with an unappealing substance and throw away in trash

Needles and sharps should be disposed of in a sharps container

"Disposal of unused medicines: what you should know". U.S. Food & Drug Administration. [www.fda.gov](http://www.fda.gov). Accessed January 28, 2020.

81

## REMS Programs & Pregnancy/Contraception

Transplant medications come with specific risks and accurate education is required for patient safety

82

## Risk Evaluation & Mitigation Strategies (REMS)

Regulated by the Food & Drug Administration

Designed to reduce the occurrence and/or severity of certain serious risks by informing and/or supporting the execution of safe use conditions

Not designed to mitigate all adverse effects of a medication

Specific requirements are specific to each medication, the nature of risk, and the setting in which it is used

U.S. Food & Drug Administration. <https://www.fda.gov>. Accessed January 27, 2020.

83


## Risk Evaluation & Mitigation Strategies (REMS)

### Eculizumab

<b>Goal of REMS:</b>	<i>To reduce meningococcal infections</i>
<b>Provider Education/Requirements:</b>	<ul style="list-style-type: none"> <li>• Risk of meningococcal infection</li> <li>• Signs and symptoms of meningococcal infections</li> <li>• Assess patient's immunization status</li> <li>• Provide prophylaxis if appropriate immunizations cannot be given</li> </ul>
<b>Patient Education/Requirements:</b>	<ul style="list-style-type: none"> <li>• Drug information handout</li> <li>• Vaccination, <i>if indicated</i></li> <li>• Prophylaxis, <i>if indicated</i></li> <li>• Patient safety pocket card</li> </ul>
<b>Documentation/Reporting Requirements:</b>	<ul style="list-style-type: none"> <li>• Provider must be registered with REMS</li> <li>• Meningococcal infections must be reported</li> </ul>

"Eculizumab REMS". U.S. Food & Drug Administration. <https://www.fda.gov>. Accessed January 27, 2020.

84



## Risk Evaluation & Mitigation Strategies (REMS)

### Mycophenolic Acid

<b>Goal of REMS:</b>	<i>To reduce embryofetal toxicity associated with mycophenolate</i>
<b>Provider Education/Requirements:</b>	<ul style="list-style-type: none"> <li>• Risk of first trimester pregnancy loss and birth defects</li> <li>• Must counsel females to utilize contraception to avoid pregnancy</li> <li>• Check pregnancy status prior to and during use</li> </ul>
<b>Patient Education/Requirements:</b>	<ul style="list-style-type: none"> <li>• Drug information handout</li> <li>• Appropriate contraceptive methods</li> </ul>
<b>Documentation/Reporting Requirements:</b>	<ul style="list-style-type: none"> <li>• Provider must be registered with REMS</li> </ul>

“Mycophenolate REMS”. U.S. Food & Drug Administration. <https://www.fda.gov>. Accessed January 27, 2020.

85



## Risk Evaluation & Mitigation Strategies (REMS)

### Mycophenolic Acid

<b>..cont. Documentation/Reporting Requirements:</b>	<ul style="list-style-type: none"> <li>• Pregnancies must be reported while on treatment</li> </ul>
<b>REMS Website:</b>	<a href="https://www.mycophenolaterems.com">https://www.mycophenolaterems.com</a>

“Mycophenolate REMS”. U.S. Food & Drug Administration. <https://www.fda.gov>. Accessed January 27, 2020.

86

## Risk Evaluation & Mitigation Strategies (REMS)

### Mycophenolic Acid Contraceptive Options

<b>Option 1</b> Methods to Use Alone	<ul style="list-style-type: none"> <li>• Intrauterine Device (IUD)</li> <li>• Tubal Sterilization</li> <li>• Male Partner Vasectomy</li> </ul>	
<b>Option 2</b> Choose 1 Hormone Method AND 1 Barrier Method	<b>Hormone</b> <ul style="list-style-type: none"> <li>• Oral Contraceptive</li> <li>• Transdermal Patch</li> <li>• Vaginal Ring</li> <li>• Injection</li> <li>• Implant</li> </ul>	<b>Barrier</b> <ul style="list-style-type: none"> <li>• Diaphragm with Spermicide</li> <li>• Cervical Cap with Spermicide</li> <li>• Contraceptive Sponge</li> <li>• Male Condom</li> <li>• Female Condom</li> </ul>
<b>Option 3</b> Choose 1 Barrier Method from each Column	<b>Barrier</b> <ul style="list-style-type: none"> <li>• Diaphragm with Spermicide</li> <li>• Cervical Cap with Spermicide</li> <li>• Contraceptive Sponge</li> </ul>	<b>Barrier</b> <ul style="list-style-type: none"> <li>• Male Condom</li> <li>• Female Condom</li> </ul>

Adapted from: "Mycophenolate REMS". U.S. Food & Drug Administration. <https://www.fda.gov>. Accessed January 27, 2020.

87

## Pregnancy & Contraception

Pregnancy should be delayed for at least 1 year after transplant

Patients should be counseled on adverse maternal, fetal, and graft outcomes

Hypertension, diabetes, and infection are particular concerns during pregnancy

Immunosuppression should be closely monitored due to changing pharmacokinetic/pharmacodynamic parameters

McKay DB, Josephson MA, Armenti VT et al. Reproduction and transplantation: report on the AST consensus conference on reproductive issues and transplantation. Am J Transplant. 2005 Jul;5(7):1592-9

88

## Contraception

### Contraceptive Options

<b>Option 1</b> Methods to Use Alone	<ul style="list-style-type: none"> <li>Intrauterine Device (IUD)</li> <li>Tubal Sterilization</li> <li>Male Partner Vasectomy</li> </ul>	
<b>Option 2</b> Choose 1 Hormone Method AND 1 Barrier Method	<b>Hormone</b> <ul style="list-style-type: none"> <li>Oral Contraceptive</li> <li>Transdermal Patch</li> <li>Vaginal Ring</li> <li>Injection</li> <li>Implant</li> </ul>	<b>Barrier</b> <ul style="list-style-type: none"> <li>Diaphragm with Spermicide</li> <li>Cervical Cap with Spermicide</li> <li>Contraceptive Sponge</li> <li>Male Condom</li> <li>Female Condom</li> </ul>
<b>Option 3</b> Choose 1 Barrier Method from each Column	<b>Barrier</b> <ul style="list-style-type: none"> <li>Diaphragm with Spermicide</li> <li>Cervical Cap with Spermicide</li> <li>Contraceptive Sponge</li> </ul>	<b>Barrier</b> <ul style="list-style-type: none"> <li>Male Condom</li> <li>Female Condom</li> </ul>

Adapted from: "Mycophenolate REMS". U.S. Food & Drug Administration. <https://www.fda.gov>. Accessed January 27, 2020.

89

## Pregnancy

Drug	Safe in Pregnancy	Washout	PK Monitoring	Present in Breast Milk	Breastfeeding Recommendation
Cyclosporine		-	Yes, troughs highly labile	Present, concentration highly variable	Not Recommended
Tacrolimus		-	Yes, whole blood concentrations ↓	Present	Likely Safe
Sirolimus		12 weeks	N/A	Unknown	Not Recommended
Everolimus		4 weeks	N/A	Present	Not Recommended

Lexi-Comp Online [Internet database]. Hudson, OH: Lexi-Comp. Updated periodically.

90

## Pregnancy

Drug	Safe in Pregnancy	Washout	PK Monitoring	Present in Breast Milk	Breastfeeding Recommendation
Mycophenolate		6 weeks	N/A	Unknown	Not Recommended
Azathioprine	at doses $\leq$ 2mg/kg	-	No	Present	Likely Safe
Prednisone		-	No	Present, dose dependent	Likely Safe
Belatacept	Case reports positive	-	No	Unknown	Not Recommended

Lexi-Comp Online [Internet database]. Hudson, OH: Lexi-Comp. Updated periodically.

91

## Pregnancy

### Guidelines from the American Society of Transplantation<sup>1</sup>

- Provide recommendations for the timing of pregnancy, management strategies including graft rejection, and immunosuppression monitoring

### Obstetrician & Gynecologist review on care of pregnant transplant recipient<sup>2</sup>

- Provide recommendations for contraceptive selection, managing comorbid conditions, nutritional considerations

All pregnancies should be reported to the National Transplant Pregnancy Registry

<sup>1</sup>McKay DB, Josephson MA, Armenti VT et al. Reproduction and transplantation: report on the AST consensus conference on reproductive issues and transplantation. Am J Transplant. 2005 Jul;5(7):1592-9.

<sup>2</sup>Deshpande NA, Coscia JA, Gomez-Lobo V et al. Pregnancy after solid organ transplantation: a guide for obstetric management. Rev Obstet Gynecol. 2013; 6(3-4):116-25.

92



**Question 3 (LO#3):** You are reviewing the chart of a 64-year old male who will be discussed at the kidney transplant listing committee. He lives alone and does not have any friends or family that live within the state. He reports that he is used to taking care of himself and that he is very independent. What is the most likely barrier for this patient to be successful with his medication regimen?

- a. Financial barrier
- b. Young age
- c. Language barrier
- d. Social support

Educate solid organ transplant candidates, recipients, donors, and caregivers on issues related to medication adherence.

Knowledge of:

- a. Education-related considerations (e.g., age, health literacy, culture)

93



**Question 3 (LO#3):** You are reviewing the chart of a 64-year old male who will be discussed at the kidney transplant listing committee. He lives alone and does not have any friends or family that live within the state. He reports that he is used to taking care of himself and that he is very independent. What is the most likely barrier for this patient to be successful with his medication regimen?

- a. Financial barrier
- b. Young age
- c. Language barrier
- d. Social support**

Educate solid organ transplant candidates, recipients, donors, and caregivers on issues related to medication adherence.

Knowledge of:

- a. Education-related considerations (e.g., age, health literacy, culture)

94

**Question 4 (LO#4):** A 30 year-old female patient received a kidney transplant 3 weeks ago. There was significant graft dysfunction and concern for acute rejection. Kidney biopsy reveals an active antibody mediated rejection (AMR). The transplant nephrologist plans to give eculizumab to treat the active AMR. The patient must be assessed for which of the following?

- a. Meningococcal vaccination
- b. Influenza vaccination
- c. Varicella vaccination
- d. Pertussis vaccination

Educate healthcare professionals, trainees, and other stakeholders concerning medication-related issues with the care of transplant patients.

Knowledge of:

- d. Risk evaluation and mitigation strategies

95

**Question 4 (LO#4):** A 30 year-old female patient received a kidney transplant 3 weeks ago. There was significant graft dysfunction and concern for acute rejection. Kidney biopsy reveals an active antibody mediated rejection (AMR). The transplant nephrologist plans to give eculizumab to treat the active AMR. The patient must be assessed for which of the following?

- a. Meningococcal vaccination**
- b. Influenza vaccination
- c. Varicella vaccination
- d. Pertussis vaccination

Educate healthcare professionals, trainees, and other stakeholders concerning medication-related issues with the care of transplant patients.

Knowledge of:

- d. Risk evaluation and mitigation strategies

96



**Question 5 (LO#5):** A 28 year-old transplant recipient would like to get pregnant in the next year. She wants to know which medication is safe for her infant if she plans to breastfeed. Which medication is safe for both pregnancy and breastfeeding?

- a. Sirolimus
- b. Cyclosporine
- c. Prednisone
- d. Mycophenolate

Educate solid organ transplant candidates, recipients, donors, and caregivers on issues related to medication adherence.

Knowledge of:

- g. Pregnancy and contraception

97

**Question 5 (LO#5):** A 28 year-old transplant recipient would like to get pregnant in the next year. She wants to know which medication is safe for her infant if she plans to breastfeed. Which medication is safe for both pregnancy and breastfeeding?

- a. Sirolimus
- b. Cyclosporine
- c. Prednisone**
- d. Mycophenolate

Educate solid organ transplant candidates, recipients, donors, and caregivers on issues related to medication adherence.

Knowledge of:

- g. Pregnancy and contraception

98

**Question 6 (LO#5):** A sexually active 22 year-old female heart transplant recipient is on tacrolimus and mycophenolate for maintenance immunosuppression. She self-reports difficulty with remembering to take her medications. She informs you that she does not use any contraceptives but would like to learn more about her options. Which contraceptive regimen would you recommend?

- a. Intrauterine device
- b. Combined oral contraceptive
- c. Progestin-only contraceptive
- d. Male condom

Educate solid organ transplant candidates, recipients, donors, and caregivers on issues related to medication adherence.

Knowledge of:

- g. Pregnancy and contraception

99

**Question 6 (LO#5):** A sexually active 22 year-old female heart transplant recipient is on tacrolimus and mycophenolate for maintenance immunosuppression. She self-reports difficulty with remembering to take her medications. She informs you that she does not use any contraceptives but would like to learn more about her options. Which contraceptive regimen would you recommend?

- a. Intrauterine device
- b. Combined oral contraceptive
- c. Progestin-only contraceptive
- d. Male condom

Educate solid organ transplant candidates, recipients, donors, and caregivers on issues related to medication adherence.

Knowledge of:

- g. Pregnancy and contraception

100



**Question 7 (LO#6):** A 73 year-old male received a kidney transplant last year. At his last clinic visit, he was confused about his medication regimen. His daughter informs you that his geriatrician started him on donepezil at his last appointment. She plans to attend his clinic visits going forward. What risk factor for nonadherence does he exhibit?

- a. Rural environment
- b. Patient beliefs
- c. High self-reported nonadherence
- d. Old age

Educate solid organ transplant candidates, recipients, donors, and caregivers on issues related to medication adherence.

Knowledge of:

- c. Risk factors for non-adherence

101



**Question 7 (LO#6):** A 73 year-old male received a kidney transplant last year. At his last clinic visit, he was confused about his medication regimen. His daughter informs you that his geriatrician started him on donepezil at his last appointment. She plans to attend his clinic visits going forward. What risk factor for nonadherence does he exhibit?

- a. Rural environment
- b. Patient beliefs
- c. High self-reported nonadherence
- d. Old age**

Educate solid organ transplant candidates, recipients, donors, and caregivers on issues related to medication adherence.

Knowledge of:

- c. Risk factors for non-adherence

102

## Key Takeaways

- Medication education should be targeted to the individual patient
- Nonadherence is common in solid organ transplant recipients
- Transplant medications have specific requirements for monitoring, use in pregnancy, and drug handling

103

## Transplant Study End Points

104

## Learning Objectives

- Review transplant study end points used in the literature to establish efficacy of clinical intervention.

105

## History of Study End Points & the FDA

### 1962 Kefauver-Harris Amendment to the Food, Drug & Cosmetic Act

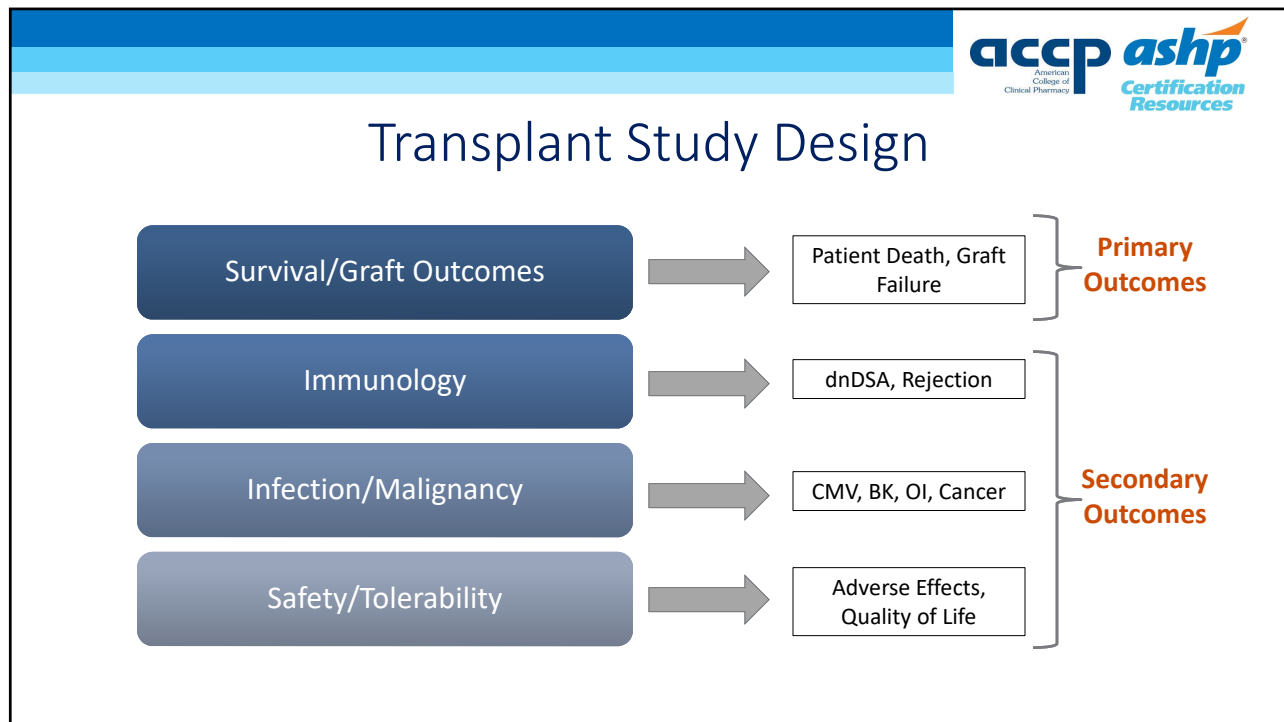
- Drugs must be effective to be approved
- Evidence of effectiveness must be derived from adequate and well-controlled clinical trials
- Surrogate end points must be supported by strong evidence to prove impact on traditional clinical endpoint

### 1992 Accelerated Approval regulations approved

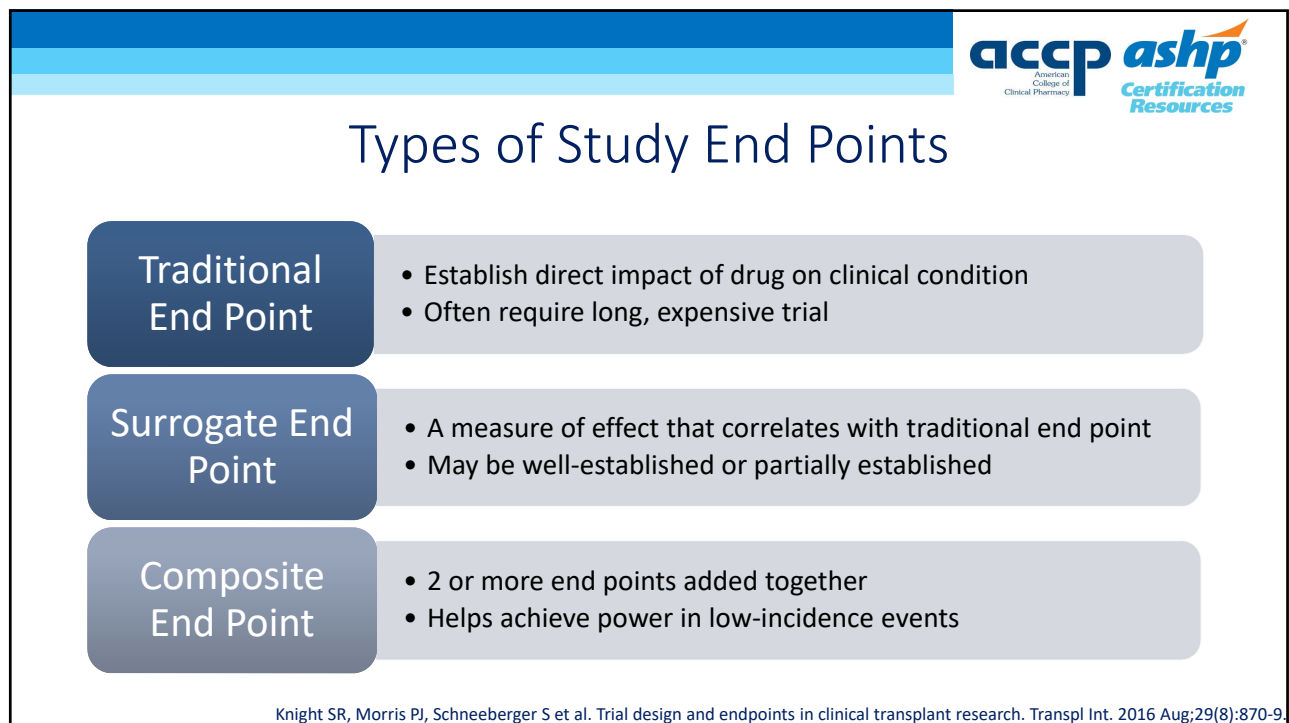
- Allows use of surrogate end points likely to predict clinical effectiveness
- Requires drug manufacturer monitoring after approval to prove surrogate end point appropriate

U.S. Food and Drug Administration. Food, Drug, and Cosmetic Act. <https://www.fda.gov/regulatory-information/laws-enforced-fda/federal-food-drug-and-cosmetic-act-fdc-act> Accessed January 30, 2020


106



107



108



## Types of Study End Points

### Traditional End Point


- Establish direct impact of drug on clinical condition
- Often require long, expensive trial

**All Organs:**

- Patient Death
- Graft Loss
- Rejection

Knight SR, Morris PJ, Schneeberger S et al. Trial design and endpoints in clinical transplant research. Transpl Int. 2016 Aug;29(8):870-9.

109



## Types of Study End Points

### Surrogate End Point

- A measure of effect that correlates with traditional end point
- Change in surrogate should change traditional end point
- May be well-established or partially established
- Faster and easier to study
- Organ and protocol-specific

**All Organs:**

- De novo DSA

<b>Kidney:</b>	<b>Liver:</b>	<b>Lung:</b>	<b>Heart:</b>	<b>Pancreas:</b>
• $\Delta$ eGFR	• AST/ALT	• BOS	• CAV	• HgbA1c
• sCr & CrClc		• CLAD	• Ejection Fraction	• Any antidiabetic use

Knight SR, Morris PJ, Schneeberger S et al. Trial design and endpoints in clinical transplant research. Transpl Int. 2016 Aug;29(8):870-9.

110

## Types of Study End Points

### Composite End Point

- 2 or more end points added together
- Helps achieve power in low-incidence events

#### Examples:

- Rejection + development of de novo DSA + graft loss
- Decreased pulmonary function + CLAD
- Change in eGFR + return to dialysis + nephrectomy

Knight SR, Morris PJ, Schneeberger S et al. Trial design and endpoints in clinical transplant research. Transpl Int. 2016 Aug;29(8):870-9.

111

## Drawbacks of Study End Points

### Traditional End Point

- Long follow up
- Expensive
- May be hard to capture event

### Surrogate End Point

- If not validated, effect may not be causal
- Validation is likely drug mechanism specific
- May miss clinically important impact on traditional end point

### Composite End Point

- Difficult to determine effect on individual components
- May mask negative effect on traditional end point
- Difficult to interpret

Knight SR, Morris PJ, Schneeberger S et al. Trial design and endpoints in clinical transplant research. Transpl Int. 2016 Aug;29(8):870-9.

112



## Transplant Study End Points

The FDA ultimately decides whether an investigational drug clinical trial end point is appropriate for approval

Transplantation study end points can be expensive and time consuming to meet

Lack of standardized end points and the development of validated surrogate end points has limited drug development

113

**Question 8 (LO#7):** The CTOT-08 study used a primary clinical composite endpoint of 24-month biopsy showing chronic injury, BPAR on any “for-cause biopsy”, or decrease in estimated glomerular filtration rate by  $> 10\text{mL/min/1.73m}^2$ . A possible limitation to using a composite endpoint is?

- a. It is difficult to capture the event in the composite endpoint
- b. 3 or more end points are required
- c. Expensive to conduct
- d. Potential to misinterpret treatment effect

Evaluate biomedical literature with regard to study design, statistical analysis, and applicability of results to the solid organ transplantation population.

Knowledge of:

- c. Transplant study endpoints

114

**Question 8 (LO#7):** The CTOT-08 study used a primary clinical composite endpoint of 24-month biopsy showing chronic injury, BPAR on any “for-cause biopsy”, or decrease in estimated glomerular filtration rate by  $> 10\text{mL/min/1.73m}^2$ . A possible limitation to using a composite endpoint is?

- a. It is difficult to capture the event in the composite endpoint
- b. 3 or more end points are required
- c. Expensive to conduct
- d. Potential to misinterpret treatment effect**

Evaluate biomedical literature with regard to study design, statistical analysis, and applicability of results to the solid organ transplantation population.

Knowledge of:

- c. Transplant study endpoints

115

## Key Takeaways

- Medications are required to show efficacy to be approved by the U.S. Food and Drug Administration
- Traditional, surrogate, and composite study end points have been established within the field of transplantation
- Standardized surrogate and composite end points may lead to more drug discovery and development within transplantation

116

# Transplant Resources, Patient Education and Transplant Study End Points

**Amanda J. Condon Martinez, Pharm.D., BCTXP, BCPS**  
**Clinical Pharmacist, Value Based Care**  
**Kidneylink**  
**Plano, TX**



117



## References

1. U.S. Department of Health & Human Services. <https://www.hhs.gov/about/agencies/index.html>. Accessed January 20, 2020.
2. Medicare Program: Hospital conditions of participation: requirements for approval and reapproval of transplant centers to perform organ transplants (42 CFR 405, 482, 488, 498). Federal Register. March 30, 2007;72:15198-15280.
3. Organ Procurement & Transplantation Network. <https://optn.transplant.hrsa.gov>. Accessed January 20, 2020.
4. United Network for Organ Sharing. <https://unos.org>. Accessed January 20, 2020.
5. U.S. Food & Drug Administration. <https://www.fda.gov>. Accessed January 20, 2020.
6. Kidney Disease: Improving Global Outcomes (KDIGO) Transplant Work Group. KDIGO clinical practice guideline for the care of kidney transplant recipients. Am J Transplant. 2009 Nov;9 Suppl 3:S1-155.
7. Bia M, Adey DB, Bloom RD et al. KDOQI US commentary on the 2009 KDIGO clinical practice guideline for the care of kidney transplant recipients. Am J Kidney Dis. 2010 Aug;56(2):189-218.
8. American Society of Transplantation. 2009. Available at <https://www.myast.org/guidelines-post-kidney-transplant-management-community-setting>. Accessed January 21, 2020.
9. Lentine KL, Kasiske BL, Levey AS et al. KDIGO Clinical Practice Guideline on the Evaluation and Care of Living Kidney Donors. Transplantation. 2017 Aug;101(8S Suppl 1):S1-S109.
10. Martin P, DiMartini A, Feng S et al. Evaluation for liver transplantation in adults: 2013 practice guideline by the American Association for the Study of Liver Diseases and the American Society of Transplantation. Hepatology. 2014 Mar;59(3):1144-65.
11. Squires RH, Ng V, Romero R et al. Evaluation of the pediatric patient for liver transplantation: 2014 practice guideline by the American Association for the Study of Liver Diseases, American Society of Transplantation and the North American Society for Pediatric Gastroenterology, Hepatology and Nutrition. Hepatology. 2014 Jul;60(1):362-98.
12. Lucey MR, Terrault N, Ojo L et al. Long-term management of the successful adult liver transplant: 2012 practice guideline by the American Association for the Study of Liver Diseases and the American Society of Transplantation. Liver Transpl. 2013 Jan;19(1):3-26.
13. Kelly DA, Bucuvalas JC, Alonso EM et al. Long-term medical management of the pediatric patient after liver transplantation: 2013 practice guideline by the American Association for the Study of Liver Diseases and the American Society of Transplantation. Liver Transpl. 2013 Aug;19(8):798-825.

118

## References

14. Robertson RP, Davis C, Larsen J et al; American Diabetes Association. Pancreas and islet transplantation in type 1 diabetes. *Diabetes Care*. 2006 Apr;29(4):935.
15. Kirk R, Dipchand AJ, Davies RR et al. ISHLT consensus statement on donor organ acceptability and management in pediatric heart transplantation. *J Heart Lung Transplant*. 2020 Jan;39(4):331-41.
16. Kobashigawa J, Colvin M, Potena L et al. The management of antibodies in heart transplantation: An ISHLT consensus document. *J Heart Lung Transplant*. 2018 May;37(5):537-547.
17. Mehra MR, Canter CE, Hannan MM et al. The 2016 International Society for Heart Lung Transplantation listing criteria for heart transplantation: A 10-year update. *J Heart Lung Transplant*. 2016 Jan;35(1):1-23.
18. Colvin MM, Cook JL, Chang P et al. Antibody-mediated rejection in cardiac transplantation: emerging knowledge in diagnosis and management: a scientific statement from the American Heart Association. *Circulation*. 2015 May 5;131(18):1608-39.
19. Costanzo MR, 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 Aug;29(8):914-56.
20. Jessup M, Banner N, Brozena S et al. Optimal pharmacologic and non-pharmacologic management of cardiac transplant candidates: approaches to be considered prior to transplant evaluation: International Society for Heart and Lung Transplantation guidelines for the care of cardiac transplant candidates--2006. *J Heart Lung Transplant*. 2006 Sep;25(9):1003-23.
21. Gronda E, Bourge RC, Costanzo MR et al. Heart rhythm considerations in heart transplant candidates and considerations for ventricular assist devices: International Society for Heart and Lung Transplantation guidelines for the care of cardiac transplant candidates--2006. *J Heart Lung Transplant*. 2006 Sep;25(9):1043-56. Erratum in: *J Heart Lung Transplant*. 2006 Oct;25(10):1276.
22. Leard LE, Holm AM, Valapour M et al. Consensus documented for the selection of lung transplant candidates: An update from the International Society for Heart and Lung Transplantation. *J Heart and Lung Transplant*. 2021 July;40(11):1349-79.
23. Martinu T, Koutsokera A, Benden C et al. International Society for Heart and Lung Transplantation consensus statement for the standardization of bronchoalveolar lavage in lung transplantation. *J Heart and Lung Transplant*. 2020 July;39(11):1171-90.

119

## References

24. Copeland H, Awori Hayanga JW, Neyrinck A et al. Donor heart and lung procurement: A consensus statement. *J Heart and Lung Transplant*. 2020 Apr;39(6):501-17.
25. Aslam S, Grossi P, Schlendorf KH et al. Utilization of hepatitis C virus-infected organ donors in cardiothoracic transplantation: An ISHLT expert consensus statement. *J Heart and Lung Transplant*. 2020 Mar;39(5):418-32.
26. Verleden GM, Glanville AR, Lease ED et al. Chronic lung allograft dysfunction: Definition, diagnostic criteria, and approaches to treatment-A consensus report from the Pulmonary Council of the ISHLT. *J Heart Lung Transplant*. 2019 May;38(5):493-503.
27. Glanville AR, Verleden GM, Todd JL et al. Chronic lung allograft dysfunction: Definition and update of restrictive allograft syndrome-A consensus report from the Pulmonary Council of the ISHLT. *J Heart Lung Transplant*. 2019 May;38(5):483-492.
28. Levine DJ, Glanville AR, Aboyou C et al. Antibody-mediated rejection of the lung: A consensus report of the International Society for Heart and Lung Transplantation. *J Heart Lung Transplant*. 2016 Apr;35(4):397-406.
29. Crespo MM, McCarthy DP, Hopkins PM et. ISHLT Consensus Statement on adult and pediatric airway complications after lung transplantation: Definitions, grading system, and therapeutics. *J Heart Lung Transplant*. 2018 May;37(5):548-563.
30. Meyer KC, Raghu G, Verleden GM et al. An international ISHLT/ATS/ERS clinical practice guideline: diagnosis and management of bronchiolitis obliterans syndrome. *Eur Respir J*. 2014 Dec;44(6):1479-503.
31. Green M, Blumberg EA, Danziger-Isakov L et al. Foreword: 4th edition of the American Society of Transplantation Infectious Diseases Guidelines. *Clin Transplant*. 2019 Sep;33(9):e13642.
32. Singh N, Huprikar S, Burdette SD et al. Donor-derived fungal infections in organ transplant recipients: guidelines of the American Society of Transplantation, infectious diseases community of practice. *Am J Transplant*. 2012 Sep;12(9):2414-28.
33. Organ Procurement & Transplantation Network. 2016. <https://optn.transplant.hrsa.gov/news/guidance-for-organ-donation-and-transplantation-professionals-regarding-the-zika-virus/>. Accessed January 21, 2020.

120

## References

34. Husain S, Sole A, Alexander BD et al. The 2015 International Society for Heart and Lung Transplantation Guidelines for the management of fungal infections in mechanical circulatory support and cardiothoracic organ transplant recipients: Executive summary. *J Heart Lung Transplant*. 2016 Mar;35(3):261-282.
35. SARS-CoV-2 (Coronavirus, 2019-nCoV): Recommendations for Organ Donor Testing. American Society of Transplantation. 2021. Available at <https://www.mvast.org/recommendations-and-guidance-organ-donor-testing> Accessed April 15, 2022.
36. Statement on Use of Monoclonal Antibody for Pre-Exposure Prophylaxis of SARS-CoV-2. American Society of Transplantation. 2022. Available at <https://www.mvast.org/covid-19-information> Accessed April 15, 2022.
37. Crow LD, Jambusaria-Pahlajani A, Chung CL et al. Initial skin cancer screening for solid organ transplant recipients in the United States: Delphi method development of expert consensus guidelines. *Transpl Int*. 2019 Dec;32(12):1268-1276.
38. Allen UD, Preiksaitis JK. Post-transplant lymphoproliferative disorders, Epstein-Barr virus infection, and disease in solid organ transplantation: Guidelines from the American Society of Transplantation Infectious Diseases Community of Practice. *Clin Transplant*. 2019 Sep;33(9):e13652.
39. National Comprehensive Cancer Network. Available at: <https://nccn.org>. Accessed January 21, 2020.
40. Lentine KL, Costa SP, Weir MR et al. Cardiac disease evaluation and management among kidney and liver transplantation candidates: a scientific statement from the American Heart Association and the American College of Cardiology Foundation: endorsed by the American Society of Transplant Surgeons, American Society of Transplantation, and National Kidney Foundation. *Circulation*. 2012 Jul 31;126(5):617-63.
41. Wanner C, Tonelli M. KDIGO Clinical Practice Guideline for Lipid Management in CKD: summary of recommendation statements and clinical approach to the patient. *Kidney Int*. 2014 Jun;85(6):1303-9.
42. Kidney Disease: Improving Global Outcomes (KDIGO) CKD-MBD Update Work Group. KDIGO 2017 Clinical Practice Guideline Update for the Diagnosis, Evaluation, Prevention, and Treatment of Chronic Kidney Disease-Mineral and Bone Disorder (CKD-MBD). *Kidney Int Suppl* (2011). 2017 Jul;7(1):1-59.
43. Cimino FM, Snyder KA. Primary Care of the Solid Organ Transplant Recipient. *Am Fam Physician*. 2016 Feb 1;93(3):203-10.
44. Maldonado AQ, Hall RC, Pilch NA et al. ASHP Guidelines on Pharmacy Services in Solid Organ Transplantation. *Am J Health Syst Pharm*. 2020 Jan 24;77(3):222-232.

121

## References

45. Alloway RR, Dupuis R, Gabardi S et al; American Society of Transplantation Transplant Pharmacy Community of Practice and the American College of Clinical Pharmacy Immunology/Transplantation Practice and Research Network. Evolution of the role of the transplant pharmacist on the multidisciplinary transplant team. *Am J Transplant*. 2011 Aug;11(8):1576-83.
46. Trofe-Clark J, Kaiser T, Pilch N et al. Value of solid organ transplant-trained pharmacists in transplant infectious diseases. *Curr Infect Dis Rep*. 2015 Apr;17(4):475.
47. American Society of Health-System Pharmacists. <https://www.ashp.org/Professional-Development/Residency-Information/Residency-Program-Directors/Residency-Accreditation/PGY2-Competency-Areas> Accessed January 21, 2020.
48. Lichvar A, Moss Chandran M, Do V et al. *Am J Health Syst Pharm*. 2021 Aug;zxab320.
49. Maldonado AQ, Tichy EM, Rogers CC et al. Assessing pharmacologic and nonpharmacologic risks in candidates for kidney transplantation. *Am J Health Syst Pharm*. 2015 May 15;72(10):781-93.
50. Maldonado AQ, Bowman LJ, Szempruch KR. Expanding transplant pharmacist presence in pretransplantation ambulatory care. *Am J Health Syst Pharm*. 2017 Jan 15;74(2):22-25.
51. Tichy EM, Pilch NA, Smith LD et al. Building a business plan to support a transplantation pharmacy practice model. *Am J Health Syst Pharm*. 2014 May 1;71(9):751-7.
52. Gast A, Mathes T. Medication adherence influencing factors - an (updated) overview of systematic reviews. *Syst Rev*. 2019 May 10;8(1):112.
53. Chisholm MA, Fair J, Spivey CA. Health literacy and transplant patients and practitioners. *Public Health*. 2007 Oct;121(10):800-3.
54. Serper M, Patzer RE, Reese PP et al. Medication misuse, nonadherence and clinical outcomes among liver transplant recipients. *Liver Transpl*. 2015 Jan;21(1):22-8.
55. Gordon EJ, Wolf MS. Health literacy skills of kidney transplant recipients. *Prog Transplant*. 2009 Mar;19(1):25-34.
56. Miller-Matero LR, Bryce K, Hyde-Nolan ME et al. Health literacy status affects outcomes for patients referred for transplant. *Psychosomatics*. 2016 Sep;57(5):522-8.

122

## References

57. Chisholm MA, Spivey CA, Picket LR. Health literacy in solid-organ transplantation: a model to improve understanding. *Patient Prefer Adherence*. 2018;12:2325-38.
58. Singleton K, Krause EMS. Understanding cultural and linguistic barriers to health literacy. *Online J Issues Nurs*. 2009;14(3). Manuscript 4.
59. Burkner BS, Gude E, Gullestad L et al. Cognitive function among long-term survivors of heart transplantation. *Clin Transplant*. 2017;31(12):e13143.
60. Cohen DG, Christie JD, Anderson BJ et al. Cognitive function , mental health and health-related quality of life after lung transplantation. *Ann Am Thorac Soc*. 2014;11(4):522-30.
61. Speros CI. More than words: promoting health literacy in older adults. *Online J Issues Nurs*. 2009;14(3)) Manuscript 5.
62. Goldfarb-Rumyantzev AS, Koford JK, Baird BC et al. Role of socioeconomic status in kidney transplant outcome. *Clin J Am Soc Nephrol*. 2006 Mar;1(2):313-22.
63. Mohan S, Mutell R, Patzer RE et al. Kidney transplantation and the intensity of poverty in the contiguous United States. *Transplantation*. 2014 Sep 27;98(6):640-45.
64. Wayda B, Clemons A, Givens RC. Socioeconomic disparities in adherence and outcomes after heart transplant. *Circ Heart Fail*. 2018 Mar;11(3):e004173.
65. Denhaerynck K, Dobbels F, Cleemput I et al. Prevalence, consequences, and determinants of nonadherence in adult renal transplant patients: a literature review. *Transpl Int*. 2005;18:1121-33.
66. Butler JA, Roderick P, Mullee M et al. Frequency and impact of nonadherence to immunosuppression after renal transplantation: a systematic review. *Transplantation*. 2004;77:769-76.
67. O'Carroll RE, McGregor LM, Swanson V et al. Adherence to medication after liver transplantation in Scotland: a pilot study. *Liver Transpl*. 2006;12:1862-68.
68. Doyle IC, Maldonado AQ, Heldenbrand S et al. Nonadherence to therapy after adult solid organ transplantation. *Am J Health Syst Pharm*. 2016 Jun 15;73(12):909-20.
69. Denhaerynck K, Steiger J, Bock A et al. Prevalence and risk factors of non-adherence with immunosuppressive medication in kidney transplant patients. *Am J Transplant*. 2007 Jan;7(1):108-16.

123

## References

70. "NIOSH list of antineoplastic and other hazardous drugs in healthcare settings, 2016". National Institute for Occupational Safety and Health. [www.cdc.gov](http://www.cdc.gov) . Accessed January 28, 2020.
71. "Disposal of unused medicines: what you should know". U.S. Food & Drug Administration. [www.fda.gov](http://www.fda.gov). Accessed January 28, 2020.
72. "Eculizumab REMS". U.S. Food & Drug Administration. <https://www.fda.gov>. Accessed January 27, 2020.
73. "Mycophenolate REMS". U.S. Food & Drug Administration. <https://www.fda.gov>. Accessed January 27, 2020.
74. McKay DB, Josephson MA, Armenti VT et al. Reproduction and transplantation: report on the AST consensus conference on reproductive issues and transplantation. *Am J Transplant*. 2005 Jul;5(7):1592-9
75. McKay DB, Josephson MA, Armenti VT et al. Reproduction and transplantation: report on the AST consensus conference on reproductive issues and transplantation. *Am J Transplant*. 2005 Jul;5(7):1592-9.
76. Deshpande NA, Coscia LA, Gomez-Lobo V et al. Pregnancy after solid organ transplantation: a guide for obstetric management. *Rev Obstet Gynecol*. 2013; 6(3-4):116-25.
77. U.S. Food and Drug Administration. Food, Drug, and Cosmetic Act. <https://www.fda.gov/regulatory-information/laws-enforced-fda/federal-food-drug-and-cosmetic-act-fdc-act> Accessed January 30, 2020.
78. Knight SR, Morris PJ, Schneeberger S et al. Trial design and endpoints in clinical transplant research. *Transpl Int*. 2016 Aug;29(8):870-9.

124