Infection is an inevitable complication of solid organ transplant. Unrecognized infection may be transmitted from a donor and result in disseminated disease in the immunosuppressed host. Recent outbreaks of deceased donor–derived infections resulting in high rates of mortality and severe morbidity have emphasized the need to be cautious in using donors with possible meningoencephalitis. Screening of organ donors for potential transmissible infections is paramount to improving transplant outcomes.

Living safely after organ transplant starts before transplant and continues after transplant. To minimize a solid organ transplant (SOT) recipient’s risk for infection and risk for injury, it is important to plan for numerous potential exposures after transplant. These include potential exposure to others with viral or bacterial illness, potential exposure to food and water sources, participation in recreational activities, resuming sexual activity, living with pets, and opportunities for travel, especially internationally. Addressing these risks head-on ensures that SOT recipients and their providers can plan accordingly and anticipate measures that will assist with maintaining such health.

This article discusses the recommended vaccines used before and after solid organ transplant period, including data regarding vaccine safety and efficacy and travel-related vaccines. Vaccination is an important part of the preparation for solid organ transplant, because vaccine-preventable diseases contribute to the morbidity and mortality of these patients. A pretransplant protocol should be encouraged in every transplant center. The main goal of vaccination is to provide seroprotection before transplant, because iatrogenically immunosuppressed patients posttransplant have a lower seroresponse to vaccines.
Strategies for Antimicrobial Stewardship in Solid Organ Transplant Recipients 535
Jonathan Hand

Complications of antimicrobial therapy, such as multidrug-resistant organisms and Clostridium difficile, commonly affect solid-organ transplant recipients and have been associated with graft loss and mortality. Although opportunities are abundant, antimicrobial stewardship practices guiding appropriate therapy have been infrequently reported in transplant patients. A patient-centered, multidisciplinary structure, using established antimicrobial optimization principles, is needed to create nuanced approaches to protect patients and antimicrobials and improve outcomes.

Multidrug-Resistant Bacterial Infections in Solid Organ Transplant Candidates and Recipients 551
Michele Bartoletti, Maddalena Giannella, Sara Tedeschi, and Pierluigi Viale

The current era is ruled by an alarming evolution of antimicrobial resistance. Solid organ transplant recipients are prone to develop infections caused by multidrug-resistant pathogens. The current challenges in this setting include screening of donors and recipients and prevention/treatment of donor-derived and posttransplant infections. The epidemiology of these infections varies between centers, type of transplanted organ, and pathogen. Treatment options are limited. Efforts to reduce carbapenem antibiotic pressure and infection control measures are necessary to reverse the spread of multidrug-resistant pathogens. Novel drugs for gram-negative multidrug-resistant bacilli may contribute to reduce carbapenemase diffusion and reduce the rate of treatment failure.

Prevention and Treatment of Cytomegalovirus Infections in Solid Organ Transplant Recipients 581
Christine E. Koval

Despite advances in prevention and treatment, cytomegalovirus (CMV) infection and disease remain an expected problem in solid organ transplant recipients. Because of the effect of immunosuppressing medications, CMV primary, secondary, and reactivated infection requires antiviral medications to prevent serious direct and indirect effects of the virus. Side effects and drug resistance, however, often limit the capacity of traditional antiviral therapies. This article updates the clinician on current and promising approaches to the management and control of CMV in the solid organ transplant recipient.

Management of BK Polyomavirus Infection in Kidney and Kidney-Pancreas Transplant Recipients: A Review Article 599
Nissreen Elfadawy, Masaaki Yamada, and Nagaraju Sarabu

BK virus (BKV) can cause graft dysfunction or failure in kidney transplant recipients and hemorrhagic cystitis in allogeneic hematopoietic stem cell transplant patients. BKV-associated nephropathy (BKVAN) emerged as a common complication in the late 1990s, probably due to the introduction of potent immunosuppressive agents. BKVAN occurred in up to 5% of
kidney transplant recipients, with graft failure in up to 70%. Since universal implementation of effective screening and treatment strategies, BKV is no longer a common cause of graft failure; reported graft loss is only 0% to 5%. This article briefly describes BK virology, epidemiology, diagnosis, and management.

**Human Immunodeficiency Virus Organ Transplantation**

Alan J. Taege

Human immunodeficiency virus (HIV) has become a chronic disease with a near-normal life span resulting in increased risk of organ failure. HIV organ transplant is a proven and accepted intervention in appropriately selected cases. HIV-positive organ transplant into HIV-positive recipients is in its nascent stages. Hepatitis C virus, high rates of organ rejection, and immune dysregulation are significant remaining barriers to overcome. This article provides an overview of the transplant needs in the HIV population focusing on kidney and liver transplants.

**Management of Viral Hepatitis in Solid Organ Transplant Recipients**

Elizabeth Buganza-Torio and Karen Elizabeth Doucette

With potent nucleos(t)ide analogue (NA) therapy, hepatitis B virus (HBV) is now an uncommon indication for liver transplant (LT) in North America. NA therapy, with or without hepatitis B immunoglobulin, results in low recurrence rates and excellent outcomes after LT. Direct-acting antiviral therapy for hepatitis C virus (HCV) results in cure in most patients, either before or after transplant. There are now descriptions of good clinical outcomes of transplant from HBV- and HCV-infected donors, as treatments are so effective and well tolerated. Hepatitis E virus in transplant requires a high suspicion to diagnose, and optimal therapy remains incompletely defined.

**Yeast Infections in Solid Organ Transplantation**

Sarah Taimur

Invasive candidiasis remains the most common invasive fungal infection following solid organ transplant (SOT), but risk factors are evolving. Current challenges include infection due to drug-resistant nonalbicans and emerging novel species such as *Candida auris*. Preventive antifungal use in SOT needs to be reexamined in light of these current challenges. Cryptococcosis is the second most common invasive fungal infection following SOT. *Cryptococcus gattii* is an emerging pathogen that can have reduced in vitro susceptibility to antifungal agents. *Cryptococcus*-associated IRIS in SOT is a clinical entity that warrants heightened awareness for timely recognition and management.

**Endemic Mycoses in Solid Organ Transplant Recipients**

Jeremy S. Nel, Luther A. Bartelt, David van Duin, and Anne M. Lachiewicz

The endemic mycoses are a group of thermally dimorphic fungal pathogens occupying a specific geographic range. In North America, the chief endemic mycoses are histoplasmosis, coccidioidomycosis, and
blastomycosis. Endemic fungi can cause serious infections in solid organ transplant recipients from primary infection, reactivation of latent disease, or donor-derived infection.

**Mold Infections in Solid Organ Transplant Recipients**

Tracy L. Lemonovich

Mold infections carry a substantial clinical and economic burden in solid organ transplant (SOT) recipients with a high overall mortality of near 30%. The most important pathogens include Aspergillus, the Zygomyces, Fusarium, Scedosporium/Pseudallescheria, and the dematiaceous (dark) molds. Risk factors for the infections vary by transplant type but include degree of immune suppression and loss of skin or mucosal integrity. Correct diagnosis usually requires histopathology and/or culture. Management often requires a multidisciplinary team approach with combined antifungal and surgical therapies. This article reviews the epidemiology, risk factors, microbiology, diagnostics, and treatment approach to mold infections in SOT recipients.

**Prevention and Management of Tuberculosis in Solid Organ Transplant Recipients**

David J. Epstein and Aruna K. Subramanian

Solid organ transplant recipients are at an increased risk of tuberculosis, and transplant candidates should be screened early in their evaluation with a detailed history, tuberculin skin test or tuberculosis interferon-gamma release assay, and chest radiograph. For latent tuberculosis treatment, isoniazid and rifamycin-based regimens have advantages and disadvantages; treatment decisions should be customized. Tuberculosis after solid organ transplant generally occurs after months or years; early infections should raise the possibility of donor-derived infections. Tuberculosis diagnosis and treatment in solid organ transplant recipients may be complicated by protean manifestations, drug interactions, and adverse drug reactions.

**Management of Mycobacterium Other than Tuberculosis in Solid Organ Transplantation**

Maricar F. Malinis

Mycobacteria other than tuberculosis are important pathogens to consider in solid organ transplant recipients. Delay in recognition and treatment may incur significant morbidity and mortality. Management of mycobacteria other than tuberculosis requires a knowledge of treatment specific for each species and drug-drug interactions between antimicrobial and immnosuppressive drugs. Therapy in solid organ transplant can be prolonged and may require a reduction in immunosuppression to improve outcomes.

**Prevention and Treatment of Clostridium difficile–Associated Diarrhea in Solid Organ Transplant Recipients**

Stephanie M. Pouch and Rachel J. Friedman-Moraco

*Clostridium difficile* infection is a significant cause of morbidity and mortality in solid organ transplant recipients. Risk factors in this population...
include frequent hospitalizations, receipt of immunosuppressive agents, and intestinal dysbiosis triggered by several factors, including exposure to broad-spectrum antimicrobials. The incidence and potential for significant adverse outcomes among solid organ transplant recipients with *C. difficile* infection highlight the evolving need for strategic *C. difficile* infection risk factor modification and novel approaches to disease management in this patient population. This article focuses on current concepts related to the prevention and treatment of *C. difficile* infection in solid organ transplant recipients.

Management of *Strongyloides* in Solid Organ Transplant Recipients

Justin Hayes and Anoma Nellore

*Strongyloides stercoralis* is a threadworm parasite with the unique capacity to complete its entire life cycle in a human host. Although asymptomatic in normal hosts, *S. stercoralis* infection in solid organ transplant recipients is often severe, disseminated, and fatal. Risk factors for disease acquisition include travel to endemic regions. Anthelminth therapy should be instituted before transplant for optimal clinical outcomes. Herein the authors review the epidemiology, biology, immune response, and diagnostic and screening strategies, as well as treatment modalities for *S. stercoralis* in the solid organ transplant population.