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Abstract

Infection with Strongyloides stercoralis is typically asymptomatic in immunocompetent hosts, despite chronic infection. In contrast, immunocompromised hosts such as solid organ transplant recipients are at risk for hyperinfection syndrome and/or disseminated disease, frequently resulting in fatal outcomes. Infection in these recipients may result from reactivation of latent infection or infection through transmission from an infected donor. We describe the Centers for Disease Control and Prevention's experience with seven clusters of donor-derived infection from 2009 to 2013. Six of the seven (86%) donors were born in Latin America; donor screening was not performed prior to organ transplantation in any of these investigations. Eleven of the 20 (55%) organ recipients were symptomatic, two of whom died from complications of strongyloidiasis. We also describe the New York Organ Donor Network (NYODN) experience with targeted donor screening from 2010 to 2013. Of the 233 consented potential donors tested, 10 tested positive for Strongyloides antibody; and 18 organs were transplanted. The majority (86%) of the donors were born in Central or South America. Fourteen recipients received prophylaxis after transplantation; no recipients developed strongyloidiasis. The NYODN experience provides evidence that when targeted donor screening is performed prior to transplantation, donor-derived infection can be averted in recipients.

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Disclosure: The authors of this manuscript have no conflicts of interest to disclose as described by the American Journal of Transplantation.
Introduction

*Strongyloides stercoralis* is an intestinal nematode found in tropical and subtropical regions worldwide, as well as temperate areas (1–3). The global burden of infection with *Strongyloides* is significant, with estimates of up to 100 million infected people (1,3). In the parasitic life cycle, filariform larvae penetrate human skin and are transported to the lungs through the bloodstream. They are then carried in respiratory secretions through the bronchial tree to the pharynx and swallowed, entering the small intestine where they can develop into adult worms. A distinct feature of the life cycle of *Strongyloides* is its ability to complete the entire cycle within one host, thereby leading to autoinfection, which can produce infection that can persist lifelong. In autoinfection, eggs that are produced by adult female worms within the intestine become rhabditiform larvae and subsequently filariform larvae. They can then penetrate intestinal mucosa or perianal skin, migrate to the lungs and begin the cycle again. Strongyloidiasis can present with diarrhea, abdominal pain, and skin manifestations but is often asymptomatic in immunocompetent individuals. However, in hosts with defects in cell-mediated immunity such as solid organ transplant (SOT) recipients, infection can result in hyperinfection syndrome and/or disseminated disease with fulminant and frequently fatal clinical presentations. Use of corticosteroids and immunosuppressive drugs are known risk factors for these conditions. Hyperinfection syndrome is defined by an increased production of larvae with parasites restricted to the pulmonary and gastrointestinal systems. Disseminated disease involves larval migration to other organs. Complications of disseminated *Strongyloides* include bacteremia and meningitis, with enteric Gram-negative bacteria gaining access to sites beyond the intestinal tract via disrupted mucosa or by migration with the larva themselves (4).

In addition to reactivation in chronically infected recipients, SOT recipients may acquire this infection through transmission from an infected donor (5–10). Previous screening recommendations have focused on preventing reactivation by testing for chronic infection in at-risk recipients by stool ova and parasite exams or IgG enzyme-linked immunosorbent assay (ELISA) antibody testing. Individuals at risk are identified by assessing potential exposure to the parasite in endemic areas based on country of origin and travel history (11–13). Some organ procurement organizations (OPOs) perform donor testing for certain pathogens of geographic significance (12), and current American Society of Transplantation (AST) guidelines recommend that evaluation for *Strongyloides* be strongly considered in transplant candidates and donors with epidemiologic risk factors or unexplained eosinophilia (14).

This article presents two clinical cases that highlight the salient aspects of the risk of strongyloidiasis in SOT recipients in the United States. We also describe the details of previously unpublished cases of donor-derived strongyloidiasis that were investigated by Centers for Disease Control and Prevention (CDC) and the experience of the New York Organ Donor Network (NYODN) which has been routinely testing at-risk donors since July 2010. To our knowledge, this is the first article to describe an OPO's experience with targeted donor screening. The findings provide further evidence to support recommending targeted donor and recipient screening for *Strongyloides* infection prior to SOT and may add to the evidence base for future guidelines.
Case Reports

Case 1

A 72-year-old Korean woman with chronic hepatitis C infection and hepatocellular carcinoma previously treated with chemoembolization underwent deceased donor liver transplantation. Posttransplant immunosuppression included tacrolimus, prednisone and mycophenolate mofetil; no induction therapy was administered. Two weeks later, the patient developed nausea, decreased appetite and weight loss that persisted for 2 months. She was hospitalized 3 months after transplantation with 3 days of diffuse abdominal pain, nausea and nonbloody emesis. Since her adherence to valganciclovir prophylaxis had been suboptimal due to intolerance, cytomegalovirus (CMV) disease was considered and intravenous ganciclovir (5 mg/kg every 12 h) was started. On hospital day 2, CMV DNA was not detected and ganciclovir was discontinued as there was no clinical improvement.

On the sixth hospital day, the patient developed altered mental status and hypoxia requiring supplemental oxygenation. Computed tomography scan of the chest revealed bilateral interstitial and alveolar pulmonary opacities. Empiric vancomycin and cefepime were initiated but blood cultures were negative. In addition to supplemental oxygen, the patient was treated with diuretics; after a right-sided thoracentesis was performed, her respiratory status improved. Pleural fluid studies were compatible with a transudative pleural effusion. On the eleventh hospital day, bronchoscopy was performed and revealed pulmonary hemorrhage and blood clots which were removed. Examination of the clot and bronchoalveolar lavage (BAL) fluid revealed larvae consistent with \textit{S. stercoralis}, and ivermectin was administered orally (200 mcg/kg daily). However, the patient's mental status worsened and mechanical ventilation was required. Albendazole 400 mg twice daily was added the next day. Lumbar puncture was performed and examination of cerebrospinal fluid (CSF) revealed no white blood cells or organisms including \textit{Strongyloides}; CSF cultures were negative. BAL cultures grew \textit{Pseudomonas aeruginosa} and \textit{Enterococcus faecalis}. The patient was treated with cefepime for 10 days for possible \textit{Pseudomonas} pneumonia. The patient had limited bowel movements during the hospitalization, but on hospital day 25, examination of stool revealed \textit{Strongyloides} larvae. Subsequent stool examinations were negative. Tracheal aspirates were also negative for parasites. Ivermectin and albendazole were discontinued on hospital day 26 after 13 and 12 days of therapy, respectively.

The hospital course was further complicated by need for tracheostomy and vancomycin-resistant \textit{E. faecium} bloodstream infection. However, there was no further evidence of \textit{Strongyloides} infection and she was eventually weaned off the ventilator and discharged to a rehabilitation facility on hospital day 64. Two years after transplant the patient was living at home with excellent liver graft function but has developed metastatic hepatocellular carcinoma.

Pretransplant testing for \textit{Strongyloides} infection was not performed. Posttransplant serum that was obtained 2 weeks after clinical presentation tested negative for \textit{Strongyloides} IgG. NYODN was contacted to explore the possibility of donor transmission. The two recipients of the donor kidneys were asymptomatic. One tested seronegative both pre- and posttransplant. The other tested negative posttransplant. Both kidney recipients were treated...
with oral ivermectin after notification of the potential disease transmission. The donor was a 45-year-old man who died from subarachnoid hemorrhage due to a ruptured cerebral artery aneurysm. He was born in Guyana and lived there for over 30 years. Donor testing for *Strongyloides* infection was not performed at the time of organ procurement in this case. After the recipient was reported to be infected, donor serum subsequently tested positive for *Strongyloides* IgG by ELISA both locally and at CDC. The sample at CDC tested positive (>1.7 units/μL) at 4.98 units/μL.

**Case 2**

The donor was a 49-year-old US-born homeless man who died from a subdural hematoma. Based on information obtained from his next of kin, he was a military veteran with no known international travel and donation occurred in Florida. Both of his kidneys were transplanted after death; no other organs were transplanted. Donor-derived infection was suspected when the left kidney recipient, a 61-year-old US-born female, presented with respiratory symptoms and was found to have *Strongyloides* parasites on microscopic examination of a BAL specimen. Pretransplant serum testing in the left kidney recipient was negative and stool examination was not performed. She was treated with oral ivermectin for 5 days followed by albendazole for 7 days and recovered without sequelae. The right kidney recipient was a 47-year-old female whose only notable complication posttransplant included chest pain diagnosed as chronic gastritis based on esophagogastroduodenoscopic biopsy. She was contacted after the left kidney recipient was found to have strongyloidiasis and received prophylaxis with a 2-day course of ivermectin followed by twice weekly ivermectin for 2 weeks. Both pre- and post-transplant serum in the right kidney recipient revealed no evidence of *Strongyloides* infection. Notably, during further investigation of these cases, a serum sample obtained from the donor was found to be strongly positive on *Strongyloides* antibody ELISA testing.

**Methods**

**CDC investigations**

CDC was notified of potential donor transmission of *S. stercoralis* by the United Network for Organ Sharing or direct physician request for parasitic disease consultation after symptomatic disease was identified in SOT recipients. Stored donor serum was tested retrospectively for evidence of *Strongyloides* infection. Pretransplant serum specimens from the SOT recipients were requested to be sent to CDC to distinguish possible reactivation of chronic infection from newly acquired, donor-derived infection. The donor and recipient specimens were tested using the crude antigen (CrAg) ELISA (15–18). This quantitative validated assay has a sensitivity of 96% and a specificity of 98%. All reactions of ≤1.7 units/μL were considered negative and all reactions of >1.7 units/μL were considered positive, indicative of infection with *S. stercoralis* at some indeterminate point in time. This assay has demonstrated a good correlation between declining serological titers and cure (16).

**NYODN screening protocol**

Based on the recommendation of the NYODN Infectious Diseases Workgroup, NYODN began targeted screening of potential donors for *Strongyloides* in July 2010. All consented
deceased donors’ next-of-kin were interviewed using a comprehensive medical-social questionnaire. This questionnaire includes questions to assess risk for infectious diseases and questions about travel history. Donors who have lived in the following areas for any period of time were tested: southeastern United States, Mexico, Puerto Rico, the Caribbean, Latin America, South America, Sub-Saharan Africa, Asia, India, and Oceania. Donor testing for *Strongyloides* was performed at Jacobi Medical Center’s Parasitic and Tropical Disease Laboratory using a recombinant antigen immunoassay, NIE ELISA (16,19). Transplant centers were informed that donor *Strongyloides* testing is pending and organ procurement was not delayed in these cases. Results were shared with all recipient centers as soon as available.

### Results

#### Summary of CDC Investigations

From 2009 to 2013 the CDC assisted in the investigation of *S. stercoralis* infection transmission from seven organ donors (Table 1) (2,6,10,20) in the following states: Pennsylvania [2], New York [2], Nevada [1], Massachusetts [1], and Florida [1]. Three of the investigations were conducted in 2012. The majority (86%) of donors was male and the median age was 49 years (range: 24–58). Six of seven (86%) donors were born in Latin America; one donor was born in the United States and had no known international travel. Donor screening was not performed prior to organ procurement in any of these investigations.

Across the seven investigations, 11 of the 20 recipients were symptomatic (Table 2) including eight kidney recipients, one liver recipient, one heart recipient, and one kidney-pancreas recipient. The majority (55%) of these symptomatic recipients was male, and the median age was 59 years (range: 14–72). Eight recipients presented with gastrointestinal complaints (i.e. nausea, vomiting and/or diarrhea) and six with respiratory complaints including shortness of breath and respiratory failure requiring intubation. Recipient infections were most commonly diagnosed by stool or BAL microscopy. The median time from transplantation to diagnosis of infection was 13 weeks (range: 7–33 weeks). Two of these symptomatic recipients died from complications of strongyloidiasis, one as a consequence of *Strongyloides* hyperinfection and the other due to disseminated disease with central nervous system (CNS) involvement (6,10).

Nine recipients did not develop evidence of posttransplant infection at the time of their last follow-up visit with their physician (Table 2). These recipients included four liver recipients and five kidney recipients; half of the recipients were male and the median age was 49 years of age (range: 41–66). Seven of the nine asymptomatic recipients received ivermectin prophylaxis. Of the remaining two recipients who did not receive prophylaxis, one experienced cardiac arrest and died prior to the diagnosis of the index case with strongyloidiasis and the other one was lost to follow up prior to the diagnosis of the index case with strongyloidiasis.
NYODN screening experience

Of the 1103 potential donors who were consented for donation, 233 (21%) were tested for Strongyloides antibody prior to organ procurement. Of the 10 (4.3%) who tested positive, seven became organ donors and three were not medically suitable for donation. In total, 18 organs were transplanted into 18 recipients from these seven suitable donors (Table 3). Of the seven donors, the majority (71%) was male and the median age was 46 years (range: 19–66). Six (86%) of the donors were born in Central or South America, and one was born in the United States but had traveled to endemic countries. Among the 17 recipients with follow-up data, 14 recipients received prophylaxis and three did not. At the last follow-up, none of the recipients had developed strongyloidiasis.

Discussion

The NYODN screening experience provides evidence that when targeted donor screening is performed prior to SOT, donor-derived infection can be averted in recipients. Eleven of the 20 recipients (55%) receiving organs from seven donors in the CDC investigations were infected post-transplant compared to none of the 14 recipients who received prophylaxis after the identification of donor infection with S. stercoralis as part of the NYODN screening program. Screening of live organ donors offers the opportunity to treat donors who test positive prior to organ donation, which may decrease the potential for transmission of Strongyloides infection to recipients.

Case report 1 highlights the importance of adhering to targeted donor and recipient screening. Although the NYODN screening program began in 2010, the donor in this case report was not tested and therefore not identified as having strongyloidiasis which resulted in donor-derived infection in the liver recipient. NYODN added a checkpoint during their preallocation huddle to review the risk factors for Strongyloides on each donor to make sure testing is sent appropriately. Case report 2 illustrates the concern for the potential of autochthonous infection in the United States; the donor, in this case, was a homeless military veteran with no known international travel. Published studies as recent as the early 1980s confirmed evidence of soil-transmitted helminths, including S. stercoralis throughout Appalachia and the southern United States (21). Most recently in 2013, a cross-sectional study conducted in a rural community in southeastern Kentucky, reported evidence of Strongyloides infection in five of the 102 participants who agreed to be tested for the study (22). Of the five participants, none reported international travel to countries where Strongyloides is known to be endemic.

The pathogenesis of Strongyloides dissemination in chronically infected deceased donors is not well defined. Chronic carriers are thought to harbor the parasite in the small intestine and may be at risk for dissemination and hyperinfection when exposed to glucocorticoids (e.g. during resuscitation efforts or organ procurement) (23,24). Many deceased donors receive methylprednisolone as part of a preconditioning regimen prior to organ procurement which has been proven to stabilize the donor, allowing for an increased number of organs to be procured per donor (25). In some cases, steroids are given hours prior to organ procurement, which is not thought to be adequate time for dissemination of Strongyloides larvae; in these cases, it is possible that the physiologic cortisol surge that occurs with an
acute stress response may lead to dissemination days prior to organ procurement. Alternatively, a small number of Strongyloides larvae may be present in organs outside of the gastrointestinal tract in the absence of reported symptoms. Further research is needed to better understand the biology of this parasite to allow for more accurate assessment of at-risk patients.

The diagnosis of latent strongyloidiasis remains a challenge despite its potential clinical importance, especially before administering chemotherapy or immunosuppression in at-risk patients such as those from regions where this infection is endemic. Stool tests have very low sensitivity and a single stool examination will not identify more than 70% of positive cases due to the low numbers and intermittent release of the parasite in stool (26). Due to the limitations of direct methods of detection, the diagnosis of strongyloidiasis is often based on immunological methods.

These assays are frequently ELISAs to detect IgG antibodies directed against antigens of S. stercoralis. CrAg preparations or recombinant antigens are employed in these assays and have the advantage of a higher sensitivity when compared to parasitological methods (16). Despite its diagnostic utility, serological assays using CrAg preparations might overestimate the prevalence of disease. This can be due to cross-reactivity with other parasitic infections. As an example, the CDC CrAg assay has a sensitivity of 96% and specificity of 98%. The specificity dropped to 72% when sera from persons with other parasitic infections were tested; however, undetected or unreported Strongyloides infection could not be ruled out in these cases (unpublished CDC data).

S. stercoralis hyperinfection syndrome is associated with significant morbidity and mortality and can be prevented by early diagnosis and treatment (27). One to 2 days of ivermectin for treatment of asymptomatic Strongyloides infection was found to be adequate in nonimmunosuppressed individuals (28). When donor-derived Strongyloides infection is considered in one recipient, it is necessary to assess the other recipients, and prophylaxis may be needed to prevent the consequences of possible transmission. To date, disease has not been reported in recipients who received prophylaxis based on suspected or proven donor infection although it is not possible to determine if transmission would have occurred in the absence of treatment. In recent cases, recipients have been treated with 2 sequential days of ivermectin (200 mcg/kg daily) with repeat therapy 2 weeks later (2) although there is currently no consensus prophylaxis recommendation. Following treatment, close monitoring of the recipient for signs of clinical disease is recommended. Serologic testing for posttransplant evidence of infection in SOT recipients is not reliable due to decreased sensitivity in the setting of immunosuppression as observed in case report 1.

In summary, comparison of the results of the NYODN screening program with the CDC investigations highlights the benefits of targeted donor screening in minimizing the risk of donor-transmitted strongyloidiasis. Our findings demonstrate the risks associated with unanticipated donor transmitted strongyloidiasis and the potential benefit of targeted donor screening. When organs are accepted from donors seropositive for Strongyloides, monitoring and treatment of recipients with ivermectin may improve outcomes. Additionally, the case reports discussed provide further evidence for the establishment and
importance of adherence to the current AST guidelines of targeted Strongyloides screening in all donors and candidates with epidemiologic risk factors or unexplained eosinophilia (14). Adoption of these recommendations by all OPOs and transplant centers may prevent the morbidity and mortality associated with strongyloidiasis in SOT recipients.

Acknowledgments

The authors acknowledge the Serology Laboratory team at CDC (Division of Parasitic Disease and Malaria, Parasitic Diseases Branch). The findings and conclusions in this article are those of the authors and do not necessarily represent the views of the Centers for Disease Control and Prevention.

References


**Abbreviations**

- **AST**: American Society of Transplantation
- **BAL**: bronchoalveolar lavage
- **CDC**: Centers for Disease Control and Prevention
- **CMV**: cytomegalovirus
- **CrAg**: crude antigen
- **CSF**: cerebrospinal fluid
- **CT**: computed tomography
- **ELISA**: enzyme-linked immunosorbent assay
- **NYODN**: New York Organ Donor Network
- **OPO**: organ procurement organization
- **SOT**: solid organ transplant
| UNOS | United Network for Organ Sharing |
Table 1
Donor demographics and characteristics in CDC investigations of *Strongyloides* infection in United States, 2009–2013

<table>
<thead>
<tr>
<th>Investigation</th>
<th>Year</th>
<th>State</th>
<th>Age/Sex</th>
<th>Birth country</th>
<th>Duration of US residence (years)</th>
<th>Cause of death</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2009</td>
<td>NY</td>
<td>55/M</td>
<td>West Indies</td>
<td>21</td>
<td>Head trauma in motor vehicle accident (MVA)</td>
</tr>
<tr>
<td>2</td>
<td>2009</td>
<td>NV</td>
<td>58/F</td>
<td>Honduras</td>
<td>Unknown</td>
<td>Respiratory failure due to asthma exacerbation</td>
</tr>
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<td>3#2</td>
<td>2010</td>
<td>PA</td>
<td>54/M</td>
<td>Dominican Republic</td>
<td>2.5</td>
<td>Head trauma secondary to gunshot wound (GSW)</td>
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<td>4#20</td>
<td>2011</td>
<td>MA</td>
<td>46/M</td>
<td>Honduras</td>
<td>7</td>
<td>Trauma in MVA</td>
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<td>5†</td>
<td>2012</td>
<td>NY</td>
<td>45/M</td>
<td>Guyana</td>
<td>14</td>
<td>Cardiac arrest, subarachnoid hemorrhage</td>
</tr>
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<td>6‡</td>
<td>2012</td>
<td>FL</td>
<td>49/M</td>
<td>United States</td>
<td>Unknown</td>
<td>Subdural hematoma</td>
</tr>
<tr>
<td>7#6,10</td>
<td>2012</td>
<td>PA</td>
<td>24/M</td>
<td>Puerto Rico</td>
<td>8</td>
<td>Head trauma secondary to GSW</td>
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# Published (references noted in superscript).
† Case report 1.
‡ Case report 2.
Table 2

CDC investigations for donor-derived Strongyloides infections in SOT recipients in the United States, 2009-2013

<table>
<thead>
<tr>
<th>Investigation</th>
<th>Year</th>
<th>State of donation</th>
<th>Organ</th>
<th>Age/ Sex</th>
<th>State of transplantation</th>
<th>Birth country</th>
<th>Pretransplant testing</th>
<th>Infected post-transplant</th>
<th>Posttransplant symptoms</th>
<th>Mode of diagnosis</th>
<th>Time from transplant to diagnosis (wks)</th>
<th>Treatment</th>
<th>One-year patient survival</th>
<th>Time from transplant to death (wks)</th>
<th>Reported cause of death</th>
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<tbody>
<tr>
<td>1</td>
<td>2009</td>
<td>NY</td>
<td>Kidney</td>
<td>40/F</td>
<td>NY (NYC)</td>
<td>West Indies</td>
<td>Yes</td>
<td>Yes</td>
<td>Gastrointestinal (GI)</td>
<td>EGD, Colonoscopy, and stool exam</td>
<td>33</td>
<td>Treated</td>
<td>Yes</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Liver</td>
<td>58/M</td>
<td>NY (NYC)</td>
<td>Europe</td>
<td>Yes</td>
<td>No</td>
<td>NA</td>
<td>NA</td>
<td>Treated/IWDT</td>
<td>Yes</td>
<td>113</td>
<td>Yes</td>
<td>Respiratory failure</td>
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<td>2009</td>
<td>NV</td>
<td>Kidney</td>
<td>60/M</td>
<td>NV</td>
<td>US</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>NA</td>
<td>Treated/IWDT</td>
<td>Yes</td>
<td>NA</td>
<td>Unknown</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Liver</td>
<td>58/M</td>
<td>PA</td>
<td>US</td>
<td>Yes</td>
<td>Yes</td>
<td>GI &amp; Respiratory</td>
<td>Skin biopsy, BAL, gastric aspirate</td>
<td>14</td>
<td>Treated</td>
<td>No</td>
<td>17</td>
<td>Sepsis, Strongyloides hyperinfection</td>
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<td>3</td>
<td>2010</td>
<td>PA</td>
<td>Kidney</td>
<td>55/F</td>
<td>NJ</td>
<td>US</td>
<td>No</td>
<td>No</td>
<td>NA</td>
<td>N/A</td>
<td>Treated/IWDT</td>
<td>Yes</td>
<td>10</td>
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<td></td>
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<td>PA</td>
<td>US</td>
<td>Yes</td>
<td>Yes</td>
<td>GI &amp; Respiratory</td>
<td>BAL, gastric aspirate, and stool exam</td>
<td>10</td>
<td>Treated</td>
<td>Yes</td>
<td>NA</td>
<td>NA</td>
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<td>Kidney</td>
<td>37/M</td>
<td>MA</td>
<td>Kenya</td>
<td>No</td>
<td>Yes</td>
<td>GI</td>
<td>BAL, gastric aspirate, and stool exam</td>
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<td>Treated</td>
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<td></td>
<td></td>
<td>Liver</td>
<td>57/M</td>
<td>MA</td>
<td>US</td>
<td>Yes</td>
<td>Yes</td>
<td>Respiratory</td>
<td>BAL and stool exam</td>
<td>14</td>
<td>Treated</td>
<td>Yes</td>
<td>NA</td>
<td>NA</td>
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<tr>
<td>5</td>
<td>2012</td>
<td>NY</td>
<td>Kidney</td>
<td>61/F</td>
<td>FL</td>
<td>US</td>
<td>No</td>
<td>No</td>
<td>NA</td>
<td>N/A</td>
<td>Treated/IWDT</td>
<td>Yes</td>
<td>14</td>
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<td>66/M</td>
<td>FL</td>
<td>US</td>
<td>Yes</td>
<td>Yes</td>
<td>Respiratory</td>
<td>BAL</td>
<td>14</td>
<td>Treated</td>
<td>Yes</td>
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<td>6</td>
<td>2012</td>
<td>FL</td>
<td>Kidney</td>
<td>47/F</td>
<td>FL</td>
<td>US</td>
<td>No</td>
<td>No</td>
<td>NA</td>
<td>N/A</td>
<td>Treated/IWDT</td>
<td>Yes</td>
<td>NA</td>
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<td>60/M</td>
<td>PA</td>
<td>US</td>
<td>Yes</td>
<td>Yes</td>
<td>Respiratory</td>
<td>EGD and stool exam</td>
<td>10</td>
<td>Treated</td>
<td>Yes</td>
<td>11</td>
<td>Pneumonia, Disseminated strongyloidiasis with CNS involvement</td>
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</tbody>
</table>

Symptomatic patients in bold; NA, not applicable.

1 As pretransplant testing was positive or unavailable for these recipients, the possibility of reactivation rather than donor-derived infection cannot be ruled out.
2 Esophagogastroduodenoscopy-obtained biopsy.
3 Bronchoalveolar lavage.
4 Intervention without disease transmission.
<table>
<thead>
<tr>
<th>Donor</th>
<th>Year</th>
<th>Age/Sex</th>
<th>Birth country</th>
<th>Duration of US residence (years)</th>
<th>Organ(s) transplanted</th>
<th>Recipient(s) Age/Sex</th>
<th>Prophylaxis given to recipient posttransplant</th>
<th>Strongyloides infection in recipient post-transplant</th>
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<tr>
<td>1</td>
<td>2011</td>
<td>66/F</td>
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NA, information not available; RK, right kidney; LK, left kidney; LI, liver; HT, heart.

JTravel to Jamaica, Haiti, Panama, Mexico.