

# The Novel 2009 H1N1 Influenza Virus Pandemic: Unique Considerations for Programs in Cardiothoracic Transplantation

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The emergence of the novel 2009 H1N1 influenza virus highlights unique aspects of transplant care that will require heightened vigilance in coming months. Recognition of the syndrome, aggressive diagnosis and early treatment should be paired with active preventative measures to stem the impact of infection in the transplant population. This special advisory addresses issues relevant to cardiothoracic transplant candidates, selection of donors, recipient management and those patients with mechanical circulatory support devices. *J Heart Lung Transplant* 2009;xx:xxx. Copyright © 2009 by the International Society for Heart and Lung Transplantation.

## INTRODUCTION

Influenza infection has been a recurrent risk for both healthy and immunocompromised populations. Annually, more than 200,000 people are hospitalized and 36,000 die from complications of seasonal influenza in the United States<sup>1</sup> with 3–5 million severe cases and 250–500,000 deaths world-wide.<sup>2</sup>

Novel Influenza A H1N1 (the Centers for Disease Control refers to this virus as the novel 2009 H1N1 influenza virus, the World Health Organization as the Pandemic H1N1 2009 virus) was identified at the end of April 2009 in Mexico and spread worldwide with pandemic status declared by the World Health Organization (WHO) on June 11, 2009 with more than one million estimated to have been infected to date in the United States alone. Those affected have been primarily younger (5–59 years) and have a history of underlying cardiac and/or respiratory diseases.<sup>3</sup> Reports of severe pneumonia with respiratory failure occurred in these high-risk populations.<sup>4</sup> The impact of this viral infection on transplant recipients, particularly cardiothoracic transplant recipients has yet to be defined. However, multiple transplant centers in the US sites have reported increased severity of infection in immunocompromised transplant recipients.<sup>5</sup> The following is an update on the evolving issues relevant to donor selection, cardio-

thoracic transplant candidates, transplant recipients and patients with mechanical circulatory support devices with regard to this new pandemic virus and potential infection, [Table 1](#).

## TRANSMISSION

The route of transmission of viral infections varies among respiratory viral pathogens. Seasonal influenza is transmitted from person-to-person through airborne droplets released from coughing or sneezing. These are deposited on the mucosal surfaces of susceptible individuals who are within three to six feet of the infected person. Indirect contact with infected droplets followed by touching eyes, nose or mouth may also result in transmission of seasonal influenza.<sup>6</sup>

Transmission routes of the novel 2009 H1N1 influenza virus have not been as thoroughly evaluated, and presently the WHO and the Centers for Disease Control and Prevention (CDC) recommend standard and droplet precautions (surgical mask, plastic apron, gloves (and goggles or eye shield if there is a risk of splashing/spraying)) along with the use of N-95,<sup>7</sup> FFP2 or FFP3<sup>8,9</sup> respirators by healthcare workers (HCW) providing direct medical care of patients infected with the novel 2009 H1N1 influenza virus. These latter more conservative precautions using respirators are recommended as limited information is available regarding the routes of transmission of this emerging novel strain of influenza H1N1. As more information accrues, these specific recommendations may change. Updates with new recommendations as they occur are available on the [www.cdc.gov](http://www.cdc.gov).

## PREVENTION MEASURES

Prevention represents the best option for decreasing the risk of infection to any patient population, but more specifically to the cardiothoracic transplant candidate and recipient. Protection of the organ transplant candidates and recipients begins with education. Each center

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**Table 1.** Key Points Regarding Novel 2009 H1N1 Influenza Virus**Vaccination**

- Vaccination for both seasonal trivalent inactivated influenza and novel 2009 H1N1 influenza vaccine should be given as soon as they become available.
- Live attenuated seasonal trivalent influenza virus vaccine (nasal flu vaccine) should be avoided in transplant candidates, transplant care providers and transplant recipients.
- Both seasonal trivalent inactivated and novel 2009 H1N1 influenza vaccine can be given simultaneously in transplant recipients but ideally when vaccine is given separately there should be a month between vaccine administration.
- Both seasonal trivalent inactivated influenza vaccine and novel 2009 H1N1 influenza vaccine can be given soon after transplant. However, the immune response of early vaccination post transplantation may only be partially protective.
- Vaccine should be administered as per manufacturer recommendations.

**Donor Evaluation**

- All potential donors should have nasopharyngeal swab and throat swabs done for novel 2009 H1N1 influenza virus testing prior to organ procurement.
- rRT-PCR is the preferred assay to diagnose influenza infection including novel 2009 H1N1 influenza virus infection.
- Negative rapid influenza detection assay does not exclude the diagnosis of novel 2009 H1N1 influenza virus infection.

should provide timely information to their patients regarding the optimal personal prevention methods using available tools like the Pandemic Influenza Advisory statement from the International Society of Heart & Lung Transplantation ([www.ishlt.org](http://www.ishlt.org)) or those from other societies ([www.a-s-t.org](http://www.a-s-t.org), [www.transplantation-soc.org](http://www.transplantation-soc.org)).

Additional educational and prevention measures are warranted in this vulnerable population of cardiothoracic transplant candidates and recipients. While a focus on the clinic and hospital setting is important, patients spend much of their time outside the medical institution. In the community, patients should avoid exposure to symptomatic contacts and keep abreast of the emerging patterns of infection in their communities. Avoidance of high-risk exposure areas during peak hours including shopping centers, restaurants and congregate gatherings including religious services should be recommended. Unnecessary air travel should be avoided. Frequent hand hygiene and cough etiquette should be practiced in the home and hospital settings. Adherence to standard and droplet precautions is essential for cardiothoracic transplant candidates and their families in the immediate period before and after transplantation as these patients are considered at higher risk of severe infection in the peri-transplant period.<sup>10</sup>

In the hospital, clinicians should follow local, regional and national recommendations for the isolation

of patients with suspected respiratory viral infection. For the novel 2009 H1N1 Influenza viral infection, single-room patient placement with standard and droplet precautions are recommended in the hospital setting with use of personal protective equipment (PPE) including respiratory N95, FFP2 or FFP3 depending on local recommendations. Correct donning and removal of PPE with methodical hand hygiene by HCW should be emphasized. For aerosol generating procedures that stimulate coughing and promote the generation of aerosols i.e. bronchoscopy, intubation, suctioning, and nebulization, airborne isolation room with negative pressure should be employed. Nosocomial transmission can be expected with breakdown of infection control measures as experienced in the SARS outbreak in Canada.<sup>5,11</sup>

In outpatient clinic or emergency room settings prompt diagnosis and early isolation of those with symptoms to avoid transmission to other patients and HCW is recommended. Symptomatic HCWs should be encouraged to stay at home and should remain at home until considered no longer infectious according to institutional policies.

In both heart and lung transplant recipients, vaccination against seasonal influenza has been shown to promote both humoral and cellular immune response to vaccine antigens.<sup>12-15</sup> However, responses to vaccine are attenuated compared to normal controls.<sup>16,17</sup> The timing of the vaccination after recent transplantation or after treatment for rejection episodes should also be considered as the immunogenicity of vaccines in these periods may be dampened and chemoprophylaxis, discussed below, may be considered. Concern regarding the development of cellular rejection with vaccination after transplantation has not been supported by the studies reported in the literature.<sup>16,18,19</sup> The effectiveness of the vaccine being evaluated for the novel 2009 H1N1 influenza virus in cardiothoracic organ transplant recipients is unknown. However, emerging data on the novel 2009 H1N1 influenza virus vaccine indicates that over 90% of healthy controls achieve antibody titers of 1:40 or greater at 21 days after vaccination in studies from Australia and the United Kingdom.<sup>20,21</sup> Further, given the extensive prior experience with seasonal influenza vaccination and the literature supporting transplant recipients' ability to mount both humoral and cellular responses, use of the vaccine as preventative measure should be promoted within the cardiothoracic transplant community. Health care workers on the transplant team, cardiothoracic transplant candidates, recipients and patients with mechanical circulatory support devices should be vaccinated for both the novel 2009 H1N1 influenza virus and the seasonal influenza virus as soon as the vaccines are available.

Another prevention method available during the coming influenza season is antiviral chemoprophylaxis, as mentioned above. Two methods can be considered, post exposure antiviral chemoprophylaxis (Post EAC), or prolonged seasonal viral chemoprophylaxis. Post EAC is recommended following close contact exposure of cardiothoracic organ candidates and recipients to patients infected with novel 2009 H1N1 influenza virus (<http://www.cdc.gov/h1n1flu/recommendations.htm>, May 6 2009; Tables 2a and 2b). Recent data in solid organ transplant, primarily kidney recipients, showed the prolonged seasonal viral chemoprophylaxis with oseltamivir for six weeks reduced the risk of seasonal influenza.<sup>22</sup> This latter method is useful in patients unable to respond to vaccine but only when the resistance pattern is known to the influenza virus of concern for that particular patient. In the 2008-9 influenza season, the majority of influenza A expressed oseltamivir resistance; as yet we do not know what the seasonal influenza 2009-2010 resistance pattern will be making the extension of these finding less applicable. The novel 2009 H1N1 influenza virus has only had scattered case reports of oseltamivir resistance to date, although many are in immunocompromised hosts.<sup>5,23</sup> As the pattern of resistance is clarified, the consideration for prolonged prophylaxis can be entertained only in selected cases with the assistance of local infectious diseases consultation. Widespread use of prolonged prophylaxis in immunocompromised hosts will increase the risk of resistance to the prophylactic agent used and this method is discouraged. Consultation with local infectious disease and clinical microbiology experts will greatly help in devising an effective preventive strategy at individual transplant centers.

The transplant team must protect itself using available prevention tools. Aggressive infection control in the clinic setting as well as the hospital is vital to prevent additional spread to HCW including nurses, physicians and hospital employees. Further, all members of the transplant team should interface with hospital infection control to obtain appropriate personal protection equipment (PPE) and receive appropriate training in wearing PPE; assist with the design

of patient flow to avoid crowded waiting areas; and develop contingency plans as hospital resources are anticipated to be strained in the event the pandemic continues.

### DIAGNOSIS

Diagnosis of an emerging infectious disease such as the novel 2009 H1N1 Influenza virus relies on several principles including clinical suspicion and accurate diagnostic testing availability. Clinical suspicion remains a critical component of diagnosis in any infectious disease. While the symptoms of seasonal influenza including fever, malaise, cough and rhinorrhea are readily apparent in the healthy host, transplant recipients may not exhibit traditional symptom patterns delaying diagnosis.<sup>24</sup> The variability of symptoms remains a concern for the novel 2009 H1N1 Influenza virus. Fever appears to be a consistent symptom; however, other symptoms including nausea and diarrhea have been more prominent. The importance of early diagnosis for both infection control and treatment cannot be overlooked and early suspicion, testing and diagnosis are warranted.

Accurate and appropriate laboratory diagnostic testing is paramount to decreasing the impact of the novel 2009 H1N1 Influenza virus. Diagnostic testing accuracy is altered by the drift and shift of the influenza viruses and each testing system needs to be reassessed for sensitivity and specificity to the new strain of virus of interest.<sup>25</sup> Our currently available tests are each limited due to either sensitivity or turn around time for our needs in transplant related issues. Diagnostic testing by EIA that was designed for rapid bedside diagnosis of seasonal influenza strains does not appear to accurately detect the novel 2009 H1N1 Influenza virus due to antigenic differences.<sup>26</sup> The CDC cautions that both a positive or negative result may be erroneous and must be considered in the context of the prevalence of the novel 2009 H1N1 Influenza virus in the population tested and the patient's clinical scenario. High viral loads, collection from the nasopharynx compared to throat swab, and early testing within the first four to five days of illness increase the likelihood of true positive rapid testing.<sup>1,27-29</sup> Should rapid testing be

**Table 2a.** Treatment and Chemoprophylaxis of Influenza Virus Infections When Oseltamivir-Resistant Viruses Are Circulating Considering Both Seasonal Influenza And Novel 2009 H1N1 Influenza Viruses

	Novel H1N1 dominant in community	Seasonal influenza dominant in community	Novel H1N1 confirmed	Co-circulation of oseltamivir-resistant seasonal influenza and novel H1N1
Treatment	Zanamivir <i>or</i> Oseltamivir	Zanamivir <i>or</i> Oseltamivir <i>plus</i> Amantadine <i>or</i> Rimantadine	Zanamivir <i>or</i> Oseltamivir (Resistant to Amantadine and Rimantadine)	Zanamivir monotherapy <i>or</i> Oseltamivir <i>plus</i> Amantadine <i>or</i> Rimantadine
Chemoprophylaxis	Oseltamivir	Zanamivir	Oseltamivir	Zanamivir

**Table 2b.** Antiviral Medication Dosing Recommendations for Treatment or Chemoprophylaxis of 2009 H1N1 Influenza Virus Infection:  
Adapted from [www.CDC.gov](http://www.CDC.gov)\*\*

Medication		Treatment (5 days)	Chemoprophylaxis (10 days)
<b>Oseltamivir*</b>			
		<b>Adults</b>	
		75-mg capsule twice daily	75-mg capsule once daily
		<b>Children <math>\geq 12</math> months</b>	
Body Weight (kg)	Body Weight (lbs)	30 mg twice daily	30 mg once daily
$\leq 15$ kg	$\leq 33$ lbs	45 mg twice daily	45 mg once daily
$> 15$ kg to 23 kg	$> 33$ lbs to 51 lbs	60 mg twice daily	60 mg once daily
$> 23$ kg to 40 kg	$> 51$ lbs to 88 lbs	75 mg twice daily	75 mg once daily
$> 40$ kg	$> 88$ lbs		
		<b>Children <math>&lt; 12</math> months</b>	
Age		12 mg twice daily	Not recommended unless situation judged critical due to limited data in this age group
$< 3$ months			
3 to 5 months		20 mg twice daily	20 mg once daily
6 to 11 months		25 mg twice daily	25 mg once daily
<b>Zanamivir</b>			
		<b>Adults</b>	
		10 mg (two 5-mg inhalations) twice daily	10 mg (two 5-mg inhalations) once daily
<b>Children (<math>\geq 7</math> years or older for treatment, <math>\geq 5</math> years for chemoprophylaxis)</b>			
		10 mg (two 5-mg inhalations) twice daily	10 mg (two 5-mg inhalations) once daily

\*Dose adjustments are recommended for patients with creatinine clearance between 10–30 mL/min. For these patients, the treatment dose is reduced to a once daily dose. Similarly, the prophylaxis dosing regimen is altered, with the dose being given every other day.

\*\*No data currently available for dose reduction in dialysis patients.

negative in a patient with suspected novel 2009 H1N1 influenza virus, empiric therapy is recommended with oseltamivir (Tamiflu) or zanamivir (Relenza) along with performance of a more definitive determination of influenza viral infection with real-time PCR (rRT-PCR) or viral isolation by culture.

While not as rapid as bedside EIA, a rRT-PCR assay was approved by the Food and Drug Administration in the US in late July 2009 for a rapid, accurate and specific diagnosis of novel 2009 H1N1 influenza virus infection. An additional RT-PCR is available for seasonal influenza. The availability of both tests will be important as seasonal influenza threatens to emerge in the face of ongoing transmission of the novel 2009 H1N1 influenza virus. The turn around time for the rRT-PCR testing currently available from commercial or reference laboratories is up to 48 hours plus travel time, if testing is not available locally. Differentiating which influenza virus is prevalent in the local population is important given the potential variability in sensitivity patterns to our anti-viral drugs. The development of antiviral resistance to oseltamivir (Tamiflu) for seasonal influenza A during the 2008–9 season demonstrates this point. Further, molecular assays specifically evaluating for oseltamivir resistance are becoming available to assist clinicians; however these are not readily available to all clinicians currently.

## MANAGEMENT/TREATMENT

Management of the novel 2009 H1N1 Influenza virus in the cardiothoracic transplant population requires dedicated teamwork. Treatment and isolation of the infected patient should be initiated early with suspicion of illness to optimize outcomes and prevent ongoing transmission of infection. The agent of choice for the novel 2009 H1N1 Influenza virus is currently oseltamivir; however, transplant clinicians should remain abreast of recommendation revisions from the CDC and WHO especially as pandemic influenza and other influenza viruses exhibit different resistance patterns, [Table 2](#). Furthermore, oseltamivir resistance has been reported in immunocompromised hosts and continued use of this medication may lead to additional emergence of viral resistance.<sup>5</sup> Consultation with local infectious diseases and clinical microbiology experts is suggested to develop dynamic treatment planning based on local, regional and national resistance patterns.

## DONOR ISSUES

All patients undergoing transplantation during a pandemic period for any pathogen need to be informed of the policy of the transplant center to address the risk of disease transmission related to the transplantation, and

specifically, the patient's risk of disease acquisition after the transplant surgeon and team decide to accept the organ for transplantation.

United Network for Organ Sharing (UNOS) in the US recommends the evaluation of recent influenza-like illness (ILI) in potential donors and those meeting the case definition for the novel 2009 H1N1 Influenza virus should have confirmatory viral testing (UNOS/OPTN <http://www.unos.org>). The Advisory Committee for the Safety of Blood Tissues and Organs (SaBTO), United Kingdom recommends testing of all potential donors.<sup>30</sup> The turn around time for the needed confirmatory testing, rRT-PCR, is a concern as it may be longer than 24 hours. Treatment for positive potential donors is recommended in accordance with CDC guidelines.<sup>7</sup> The following donor scenarios reflect current recommendations, Table 3.

### 1. Potential donor dying of proven novel 2009 H1N1 influenza as primary cause of death

Such patients are very unlikely to become donors. There are reports of involvement of many organs other than lung, and of persisting viremia. Organs from such a patient should not be harvested.<sup>30</sup> The acceptance of the organ is always at the discretion of the transplant center; however, most experts recommend that donor lungs from novel 2009 H1N1 infected donors be

avoided especially as seasonal influenza transmission has been reported previously.<sup>31</sup>

### 2. Potential donor with confirmed concomitant diagnosis of novel 2009 H1N1 influenza

Such patient may not be suitable for lung donation. If the donor has been diagnosed in the community or after admission to hospital, and confirmed by testing but comes to donation because of another condition (e.g. intracerebral bleed), treatment should be given to the recipient and informed consent should be obtained from the recipient. The SaBTO the UK's Advisory Committee on Safety of Blood, Tissue and Organs recommends at least 10 days and the Australian Organ and Tissue Donation and Transplantation Authority (AOTDTA) recommends more than 48 hours elapse between diagnosis of novel 2009 H1N1 influenza virus in a potential donor and acceptance of the organ with intercurrent treatment of the donor and post-transplant prophylaxis in the recipient for proven or suspected cases in donors.<sup>30,32</sup> (UNOS, have reported transplantation of non-lung organs from a novel 2009 H1N1 donor in Australia but the outcome has not yet been reported. ([www.UNOS.org](http://www.UNOS.org))).

### 3. Potential donor where infection is raised as a possibility (suspected novel 2009 H1N1 influenza)

Donor in whom there is a contact history, suggestive symptoms, or a temperature >38°C. Nasopharyngeal

**Table 3.** Guidelines for the Management of Cardiothoracic Donor and Recipients at Risk of Novel 2009 H1N1 Influenza Virus Infection\*\*

Category	Description	Organ procurement		Immediate post-operative management	
		Lung	Heart	Antiviral drugs	Immunosuppression
1	Potential donor dying of proven novel 2009 H1N1 influenza virus	No	No	Not applicable	Not applicable
2*	Potential donor with confirmed concomitant diagnosis of novel 2009 H1N1 influenza virus	No	Yes*	Oseltamivir in treatment doses	Avoid induction with monoclonal antibody Consider decreasing steroids
3*	Potential donor with suspect case of novel 2009 H1N1 influenza virus				
	a) Sign and Symptoms and strong contact history	No	Yes*	Oseltamivir in treatment doses	Avoid induction with monoclonal antibody
	b) Sign and Symptoms and Weak contact history	No*	Yes*	Consider Oseltamivir in Treatment doses until donor confirmatory tests available (see text)	Consider decreasing steroids Consider decreasing steroids
4	Donor with a previous history of novel 2009 H1N1 influenza virus. Received treatment ≥ 5 days	Yes	Yes	Observe clinically	Manage according to the transplant center protocol
5	Other donors in the setting of positive cases other patients in ICU/hospital ward	Yes	Yes	Consider Oseltamivir in Treatment doses until donor confirmatory tests available (see text)	See category 2

Recommendation for Deceased Donors. \*All donors in category 2,3 should have received at least 2 days of appropriate antiviral therapy (AOTDTA, Australia (32) or at least 10 days (SaBTO, UK(30)).

\*\*Organ recovery decision at the discretion of the transplanting surgeon/center and should be decided case by case with the assistance of an infectious disease or clinical microbiology expert.

(NP) swab and throat swab for rapid test, rRT-PCR and viral culture where available. A positive result (if time permits) puts the donor in category 2 above.

If time does not permit, the following scenarios are considered:

A: Donor in whom there is a **strong contact (household) history of exposure** with no clinical signs or symptoms of infection: Lungs should not be recovered. Treat donor for 2-10 days before recovering other organs (SABTO, AOTDTA).

B: Donor in whom there is a **weak contact history (not household) with suggestive symptoms**, or a temperature  $>38^{\circ}\text{C}$ : lungs should not be recovered. Treat donor for 2-10 days before recovering other organs.<sup>32</sup> Treatment should be given to the recipient while waiting for the confirmatory testing from the donor. If the donor testing is positive for novel 2009 H1N1, a 10 day treatment course should be completed. If confirmatory testing of novel 2009 H1N1 from the donor is negative, treatment may be discontinued.

In scenarios A and B above, other organs should only be used after discussion with the recipient medical team and the final decision lies with the implanting surgeon weighing the balance of risks for the particular individual involved and the risk of infecting the recipient. Treatment should be considered for the organ recipient. Posttransplantation, the clinical manifestations of the donor derived novel 2009 H1N1 influenza is unknown.

**4. Donor with a previous history of novel 2009 H1N1 Influenza** more than 5 days since infection onset, and there has been full clinical recovery. Donation of all organs can proceed. NP and throat swab for rapid test, rRT-PCR and viral culture where available should be taken.

**5. All other Donors** including those from inpatient units where novel 2009 H1N1 influenza patients are present. Donation should proceed along normal lines. NP and throat swabs and BAL/sputum should be taken from all donors. Treatment should be given to any recipient of a donor proved to be positive (Figure 1).<sup>32</sup>

#### PATIENTS CALLED IN FOR TRANSPLANTATION

For patients with positive symptoms of fever, cough, and or diarrhea, one must obtain a NP and a throat swab for rapid test, rRT-PCR and viral culture where available. If lower respiratory symptoms present, BAL or sputum is also recommended. If negative, transplant may proceed. It is recommended that a NP and throat swab for rRT-PCR testing be obtained on all patients admitted for transplant to capture incubating virus at time of transplant as this will require treatment doses instead of prophylactic doses after transplant if positive.

#### IMMEDIATE POST TRANSPLANT RECIPIENTS

The management of the immediate post transplant patient will ultimately be determined by the final results of the rRT-PCR for novel 2009 H1N1 Influenza virus performed on the donor and in the recipient prior to transplant. In cases where the donor has a positive rRT-PCR for novel 2009 H1N1 Influenza virus, the use of induction therapy particularly with monoclonal antibody should be avoided and immediate post operative steroid doses should be lowered. The recipient should receive the treatment with oseltamivir for 10 days. Similarly, if the rRT-PCR test for novel 2009 H1N1 Influenza virus of the recipient collected prior to transplant is positive, then the recipient should receive oseltamivir for 10 days. A recipient of a category 3 donor should also be considered for treatment with oseltamivir if the clinical or contact history is strongly positive while waiting for the confirmatory testing from the donor. If the donor testing is positive for novel 2009 H1N1 Influenza virus, a 10 day treatment course should be completed. If confirmatory testing of novel 2009 H1N1 from the donor is negative, treatment may be discontinued. Immediate post transplant management of the recipients of the category 4 or 5 should proceed according to the respective protocols of the transplant centers. Chemoprophylaxis of the recent transplant is recommended only in the outbreak setting of the hospital or after exposure to household contact, as described below.

#### OTHER TRANSPLANT RECIPIENTS

Patients who are not immediately post transplant and admitted for non-influenza like illness should be managed as per standard of care. Routine rRT-PCR for novel 2009 H1N1 Influenza virus of transplant recipients admitted for non-influenza like illness is not recommended. Prophylaxis with oseltamivir or zanamavir in these patients should be considered only in the outbreak setting of the hospital. Other recipients who are at home and had known exposure to close contacts may be considered for post exposure prophylaxis for 10 days with zanamavir or oseltamavir. The choice of drug may change depending on the development of resistance pattern in the community.

#### CONCLUSIONS

The novel 2009 H1N1 Influenza virus represents a greater challenge to cardiothoracic transplant teams as it is a viral infection of the respiratory tract. Interaction with organ procurement organizations for organ selection must take into account emerging data on the use of organs from patients infected and treated for the novel 2009 H1N1 Influenza virus.

Improved diagnostic testing with shorter turn around times are needed in donor evaluation. Individual patient education, prevention measures and treatment strategies will also require attention to the local patterns of infection, availability of the novel 2009 H1N1 Influenza virus vaccination, and emerging patterns of antiviral resistance. Finally, efforts to contain and prevent the novel 2009 H1N1 Influenza virus from spreading within the cardiothoracic transplant setting can be accomplished through infection control measures. The risk of infection within our communities is more difficult to tackle, but the transplant team can encourage and empower transplant recipients by education to protect themselves and report early illness symptoms.

## DISCLOSURE STATEMENT

LDI, SH, MLM and MMH have no disclosures regarding this manuscript.

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