

Joint Statement about COVID-19 Vaccination in Organ Transplant Candidates and Recipients

Community spread of SARS-CoV-2 is waning in some parts of the world, especially in those areas with greater vaccine acceptance, while activity is increasing in other parts of the world due to a variety of factors, including highly transmissible variants and low rates of vaccination. Information about COVID-19 vaccine responses in transplantation is rapidly evolving. Because vaccines are critical to containing further spread of the pandemic, there has been interest in optimizing vaccine responses in vulnerable populations, including solid organ transplant (SOT) recipients. To date, we have learned the following:

- Antibody responses to COVID-19 vaccines in transplant recipients are diminished compared with the general population.¹⁻¹⁶ However,
 - The level of protective antibody has yet to be defined. Based on data derived from trials in the general population, there is an inverse correlation between the level of neutralizing antibody to SARS-CoV-2 spike protein and symptomatic disease. Additionally, the ability of some monoclonal antibodies against spike proteins to attenuate disease shows the protective nature of antibody. While this is true for populations, the individual antibody response remains unpredictable.
 - Three dose mRNA vaccination is associated with improved rates of serum neutralization against SARS-CoV-2 variants in transplant recipients versus 2-dose vaccination.¹⁷
 - The post-vaccination antibody threshold for protection against severe COVID-19 is significantly lower than that required to prevent viral infection.¹⁸
 - Determination of protective levels of antibody is confounded by the wide variety of antibody tests that are commercially available, with no direct means to compare results from the different tests.
- The protective components of Cellular (T cell and NK T cells) and humoral responses (IgG/IgM vs IgA) may not be linked in individual SOT recipients; it is possible to have an active acquired or innate immune response in the absence of antibody and vice versa.^{3,6,9-11,16} However, the clinical consequence of this divergence is not known nor measurable.
- Antibody testing is currently not recommended by the FDA due to the following considerations:
 - Most commercially available tests do not examine neutralizing antibody to the spike protein receptor binding domain (RBD).
 - Many commercially available tests are qualitative.
 - The analytical cut-off values for antibody detection are not necessarily the same as clinically relevant values.
 - There is no commonly agreed upon titer that has been defined as protective against SARS-CoV-2 infection.
 - Cellular responses may occur in the absence of measurable antibody
 - However, failure to mount any detectable antibody response to the spike protein after vaccination is concerning for increased risk for COVID-19 acquisition, especially with more transmissible variants.
- Clinical effectiveness studies in SOT show an overall reduction in infections after 2-dose vaccination and an effectiveness of 59% (in a CDC study that combined the SOT and stem cell transplant population).^{19,20}

Moreover, breakthrough infections occur at greater rates and greater severity than in the general population.²¹

- While the level of immunosuppression, specifically the use of antiproliferative agents, has been implicated as a factor in poor antibody response after vaccination, there is no reliable guide for adjustment of immunosuppression in anticipation of vaccine responses. Current data suggest that providing a third dose of mRNA vaccine to SOT recipients that have previously received two doses of mRNA vaccine can increase antibody titers to SARS-CoV-2;²²⁻²⁵ in a recent, double-blind, randomized placebo-controlled trial, a third dose mRNA vaccine provided at an interval of two months after the second dose significantly increased antibody titers, neutralizing antibody, and cellular immune response to SARS-CoV-2 compared to third dose placebo.²⁶ For individuals who have received a single dose of an adenovirus vector vaccine, a second vaccine dose with either the same vaccine or an mRNA vaccine is indicated for all individuals, including transplant candidates and recipients. It is unknown if a specific vaccine is preferable for this additional dose. Early data from the UK in healthy individuals suggests that using an mRNA vaccine may be preferred to additional adenoviral-vector vaccine doses though transplant-specific data is not available.²⁷
- The published data to date suggest that additional doses are safe and reasonably well-tolerated with no evidence of an increased risk of rejection attributable to vaccine.
- Clinical effectiveness of expanded vaccine dosing is pending. There are insufficient data to recommend the use of antibody testing to guide decision-making about additional doses. The effect of additional vaccine doses for vector-based and other vaccines is not clear.
- Many of the reports to date focus on kidney transplant recipients, but it does appear that other organ recipients experience similar responses to additional vaccine doses. Despite 3 doses of mRNA vaccine, there are still patients that have poor antibody responses and we do not know what interventions, if any, might be indicated. Whether altering the vaccine used for the additional dose (e.g. giving adenovirus vector following mRNA or vice versa) is unknown.

RECOMMENDATIONS:

- We strongly recommend that all eligible children and adult transplant candidates and recipients be vaccinated with a COVID-19 vaccine that is approved or authorized in their jurisdiction.
- Whenever possible, vaccination should occur prior to transplantation (ideally with completion of vaccine series a minimum of 2 weeks prior to transplant).
 - We support the development of institutional policies regarding pre-transplant vaccination. We believe that this is in the best interest of the transplant candidate, optimizing their chances of getting through the perioperative and post-transplant periods without severe COVID-19 disease, especially at times of greater infection prevalence.
- SOT recipients that have received 2-dose mRNA vaccine should also receive a third dose of mRNA vaccine to complete the primary series.
 - Further research is needed to clarify if additional doses of other vaccines, including adenoviral vector vaccines will provide similar benefit. At this time, patients who have received a single dose of adenovirus vector vaccine (typically Johnson & Johnson/Janssen) would benefit from a second dose of vaccine and data from immunocompetent hosts suggest that that an mRNA vaccine dose may offer

benefits. Consequently, we recommend that mRNA vaccine be considered for transplant recipients that previously received an adenoviral vector vaccine. There are limited data to provide guidance regarding additional doses of COVID-19 vaccine for those who have received 2 doses of Astra Zeneca based adenovirus vaccine, however it is reasonable to provide 3rd doses for these individuals and mRNA vaccines can be used in this circumstance.

- There are no data currently to support adjustment of immunosuppression in anticipation of additional doses of vaccination.
- Antibody testing is not required prior to or after additional vaccine doses and is not currently recommended by the FDA.
 - However, individual physicians and patients may decide that antibody testing is desirable to discern the individual patient's response to the vaccine antigen with a resultant discussion about the interpretation of the test results and the consequences/risks of acquiring COVID-19 infection. The discussion will need to include additional issues relevant to the patient, such as local prevalence of SARS-CoV-2 and its variants, personal situations relating to immunosuppression and transplant infections and the vaccination level in the household that may be pertinent.
- It is strongly recommended that living donors be vaccinated with a minimum of two-doses of vaccine and boosters are encouraged. This is to minimize peri-operative risks for donor (and spread to the recipient if there is contact).²⁸
- All eligible household and close contacts of SOT recipients should be vaccinated against SARS-CoV-2 to minimize risks to the recipient.
- It is strongly recommended that all health care providers be vaccinated against SARS-CoV-2 to foster a safer environment for our patients and maintain a skilled workforce.
- While COVID-19 variants continue to evolve and circulate in the community and the extent of protection is still unknown in transplant recipients, it is recommended that SOT candidates and recipients continue to adhere to protective measures including masking in public spaces, social distancing, frequent hand washing, and avoiding indoor crowds. These measures should be followed regardless of whether the patient has received additional doses of vaccine. Information about viral variants, vaccine effectiveness and perceived/real risk is changing rapidly and it is important to address the concerns of transplant recipients.
- We recommend ongoing monitoring of the regulatory and health department websites to obtain up to date COVID-19 prevalence and vaccine updates.
- We strongly encourage participation in clinical studies to determine the effects of additional doses or other strategies to improve vaccine responses.
- We strongly urge funding agencies to invest in research evaluating vaccine immunogenicity, vaccine effectiveness, and strategies to enhance vaccine responses in vulnerable populations, including SOT candidates and recipients, who may fuel the perpetuation of the pandemic.

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