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# Practice Patterns and Attitudes Regarding Pregnancy and Parenthood After Lung Transplantation

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**Background.** Parenthood after lung transplantation (LuTx) is uncommon. Although data exist regarding practice patterns surrounding pregnancy after heart transplantation, there are no data specific to LuTx recipients and parenthood more broadly. **Methods.** We conducted a voluntary, anonymous online survey between October and December 2021. It was distributed electronically to select LuTx units and advertised to LuTx providers internationally. **Results.** A total of 103 responses were included in our analysis. Respondents were primarily women (n = 63; 62%) and included LuTx pulmonologists (n = 59; 58%) or nurses and transplant coordinators (n = 28; 27%). The majority were from centers performing >40 LuTx annually (n = 53; 52%) and had >10 y of transplant experience (n = 56; 55%). Most respondents discuss fertility issues with recipients (n = 63; 62%), but centers lacked clear policies relating to female (n = 51; 70%) and male (n = 62; 83%) fertility and parenthood. Few were aware of policies regarding assisted reproduction and fertility preservation (n = 13; 13%) or pregnancy (n = 23; 22%). Many cited ethical concerns regarding parenthood post-LuTx (n = 38; 37%), but most were supportive of the use of surrogacy by female recipients (n = 74; 92%) and felt there were no contraindications to parenthood in male recipients (n = 59; 59%). Although geography influenced some logistical issues around care provision, general attitudes toward parenthood in LuTx recipients were unaffected by respondent age, sex, location, or experience. **Conclusions.** Although providers were overall supportive of post-LuTx parenthood, the absence of peer-reviewed evidence, expert consensus, and policy-driven guidance may be a significant barrier to safe and successful parenthood in LuTx recipients.

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N.S.G. designed and distributed the survey, monitored data collection, analyzed the data, and drafted and revised the article. G.S. and E.M.D. assisted with survey design and drafted and revised the article. B.L. assisted with survey design, distributed the survey, and drafted and revised the article. V.G. distributed the survey and drafted and revised the article. M.P. initiated the project, designed and distributed the survey, analyzed the data, and drafted and revised the article.

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Parenthood after lung transplantation (LuTx) is poorly studied but is increasingly achievable for many recipients.<sup>1-3</sup> Advances in immunosuppression and assisted reproduction techniques (ARTs) have lessened some of the risks associated with post-LuTx pregnancy but not ameliorated them completely. Although survival post-LuTx is increasing, it remains lower than for other solid organ transplants, with a median life expectancy of 6.7 y.<sup>4</sup> The recently published International Society for Heart and Lung Transplantation (ISHLT) Consensus Statement on Reproductive Health after Thoracic Transplantation highlights the need for careful planning and monitoring for safe reproduction after transplantation.<sup>5</sup> Limited data exist describing parenthood after LuTx. Current literature is limited to case series and registry data primarily concerned with pregnancy outcomes. Importantly, there is a knowledge gap concerning the use of ARTs by LuTx recipients, parenthood in male recipients, and the pursuit and experience of parenthood in this population. With this survey, we aimed to explore LuTx provider practice and attitudes toward recipient parenthood more broadly rather than pregnancy alone. Questions explored practice patterns and provider attitudes toward male and female recipient fertility and assisted reproduction, pregnancy, and breastfeeding.

## MATERIALS AND METHODS

We conducted a voluntary, anonymous online survey of LuTx providers, including medical and nursing staff,

transplant coordinators, and pharmacists, between October and December 2021. It was reviewed and approved by The Alfred Hospital's Research Ethics Committee before its distribution. The survey was advertised on web-based message boards, including the ISHLT internal member message board, and on the Australian Transplant Nurses Association internal message board. The link was also distributed directly via email to 28 LuTx providers at major transplant centers, with a request to be distributed to their relevant colleagues for their participation. Study data were collected via the Qualtrics XM platform, and software security measures prevented multiple submissions from the same device. Data were stored securely in Qualtrics XM on the Monash University server, accessible only by the study investigators.

The survey comprised 43 multiple-choice and free-text questions (Supplemental Methods, SDC, <http://links.lww.com/TXD/A613>). The responses were anonymized, but demographic data were collected regarding sex, age, profession, and years of transplant experience, including caring for pregnant recipients. Data were also obtained regarding work region and center size as measured by the number of transplants performed annually. Qualtrics XM was used for statistical analysis, and logistic regression was used to identify potential predictors of provider practice and attitudes toward recipient parenthood. A *P* value of <0.05 was considered statistically significant.

## RESULTS

### Respondents

Responses were received from 144 individuals, but 31 completed <50% of the survey and were excluded from analysis (Table 1). The majority of respondents were LuTx pulmonologists (*n* = 59; 58%), followed by nurses or LuTx coordinators (*n* = 28; 27%), surgeons (*n* = 4; 4%), and other transplant providers (*n* = 11; 11%). Most respondents identified as women (*n* = 63; 62%) with a median age of 43 y. The largest percentage of respondents were from Europe (*n* = 40; 39%), North America (*n* = 31; 30%), or Australia (*n* = 25; 25%). Thirty-nine percent of respondents worked in a center which performed >50 LuTx annually (*n* = 40; 38.8%). Most respondents had >10 y of transplant-specific experience (*n* = 56; 55%), but the majority had not personally been involved in the care of pregnant LuTx recipients (*n* = 55; 54.4%), and in those who had, the majority (*n* = 34; 70%) had only been involved in 1 to 4 pregnancies (Figure 1).

### Contraception After LuTx

There was significant gender disparity in counseling regarding contraception. Although 72% of respondents (*n* = 74) routinely counseled female patients regarding contraception use, only 34% (*n* = 35) routinely counseled male recipients (Figure 2). Almost three-quarters of respondents reported informing male recipients that conceiving a child while taking certain immunosuppression agents is contraindicated (always 25%, sometimes 48%; Figure 3). Less than half of respondents counseled male recipients to use barrier contraception for the purpose of preventing pregnancy (*n* = 44; 43%). Who prescribed contraception for female recipients was heavily determined by geographical location, with primary care providers

**TABLE 1.**  
Characteristics of respondents

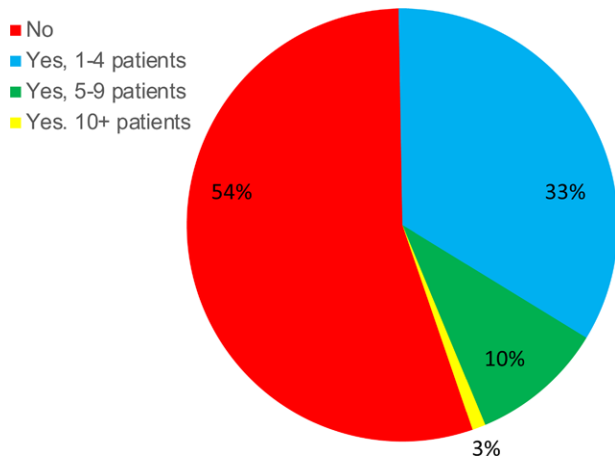
Respondent characteristics	Total = 103 respondents, n (%)
Age, y (median)	43
Sex	
Female	63 (61)
Male	39 (38)
Unknown	1 (1)
Geographic location	
Australia	25 (24)
Europe	40 (39)
North America	31 (30)
South America	1 (1)
Asia	1 (1)
Other	4 (4)
Unknown	1 (1)
Specialty	
LuTx pulmonologist	59 (57)
Nurse or transplant coordinator	28 (27)
Surgeon	4 (4)
Other	11 (11)
Unknown	1 (1)
No. of LuTx performed annually (center volume)	
1–4	1 (1)
5–9	6 (5.8)
10–19	12 (11.7)
20–29	13 (12.6)
30–39	17 (16.5)
40–49	13 (12.6)
≥50	40 (38.8)
Years of LuTx-specific experience	
<5	26 (25.2)
5–10	20 (19.4)
10–20	38 (36.9)
>20	18 (17.5)
Unknown	1 (1)

LuTx, lung transplantation.

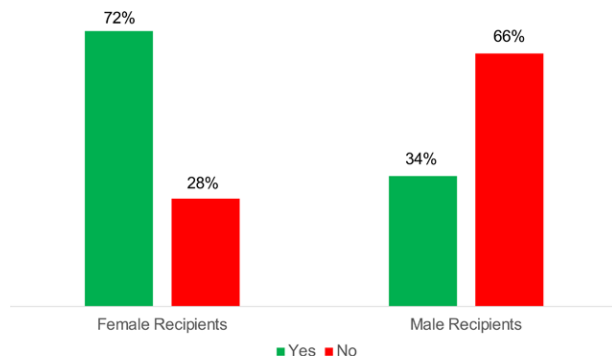
predominant in Australia (91%), Europe (51%), and Canada (71%), whereas most contraceptive prescribing in the United States was done by gynecologists (71%).

### Fertility

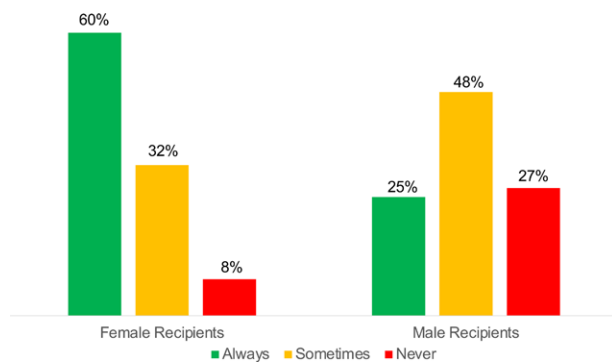
Most respondents worked at centers with no established policy regarding fertility and parenthood for female or male LuTx recipients (no female recipient policy: *n* = 51; 70%; no male recipient policy: *n* = 62; 83%). Less than half of respondents always discuss the impact of transplantation and immunosuppression on fertility with female transplant candidates of child-bearing age (*n* = 45; 44%), and only 16% (*n* = 16) have similar discussions with male potential recipients (Figure 4). A significant proportion of respondents reported never addressing fertility with patients before transplantation, although this is more likely to be absent from discussions with male recipients (*n* = 20; 20% never discuss with female patients; *n* = 32; 32% never discuss with male patients). This is also somewhat related to professional roles, with LuTx pulmonologists more likely than other LuTx providers to discuss issues of fertility with recipients. LuTx pulmonologists reported discussing fertility with female recipients before LuTx in the majority of cases (always 51%, sometimes 44%, and never 5%) but



**FIGURE 1.** Have you personally been involved in the care of pregnant LuTx recipients? LuTx, lung transplantation.



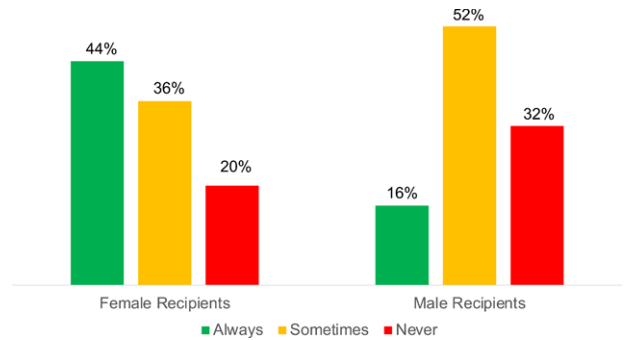
**FIGURE 2.** Do you routinely counsel LuTx recipients regarding the use of contraception? LuTx, lung transplantation.



**FIGURE 3.** Do you specifically inform LuTx recipients that pregnancy or conceiving a child while taking certain immunosuppression agents is contraindicated? LuTx, lung transplantation.

less frequently with male candidates (always 15%, sometimes 56%, and never 30%). Few respondents reported that their discussions regarding parenthood and fertility are affected by the patient’s cultural or religious background (n = 16; 16%).

Few respondents worked in centers with an established policy regarding assisted reproduction and fertility preservation (n = 13; 13%). With regard to female LuTx recipients, most respondents would endorse the use of fertility preservation techniques and in vitro fertilization if recommended by a fertility specialist (oocyte freezing and ovarian tissue preservation: n = 56; 79%; in vitro fertilization: n = 45; 68%). Most



**FIGURE 4.** Before transplant, do you routinely discuss the impact of transplantation and immunosuppression on fertility with male patients or female patients of child-bearing age?

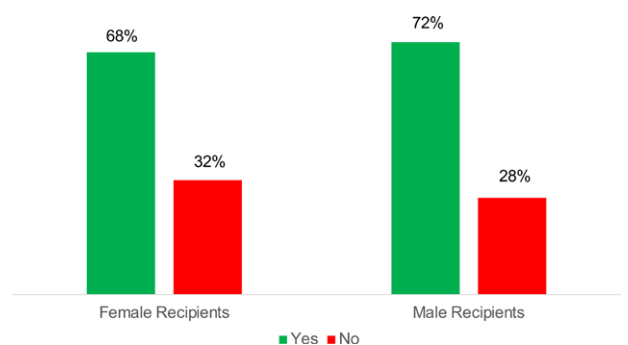
respondents disagreed with the assertion that it is difficult to refer patients for fertility preservation (n = 53; 52%). The majority supported the concept of surrogacy for female LuTx recipients who wish to pursue parenthood (n = 74; 93%).

### Preconception Counseling

A similar proportion of respondents would counsel the partners of male recipients and pregnant female recipients regarding the possibility that they will become a sole parent given the projected survival of LuTx recipients (male recipients: n = 73; 72%; female recipients: n = 70; 68%; Figure 5). Twenty-one percent of respondents would not recommend preconception genetic counseling for female recipients (n = 22), and 16% would not recommend screening for male recipients (n = 16). Although some (18% for male recipients and 13% for female recipients) responded that referral for preconception genetic screening would be dependent on certain factors, less than half of respondents would recommend preconception genetic counseling for LuTx recipients with cystic fibrosis (male recipients: n = 48; 47%; female recipients: n = 44; 43%).

### Posttransplant Pregnancy, Breastfeeding, and Fatherhood

Most respondents believed that pregnancy is feasible in selected LuTx recipients (n = 56; 54%). No respondents thought that it was feasible for all recipients. A significant proportion of respondents felt that other avenues, such as surrogacy or adoption, should be considered for female recipients



**FIGURE 5.** Would you counsel the partners of LuTx recipients on the possibility that they will be a sole parent given the projected survival of LuTx recipients? LuTx, lung transplantation.

( $n = 43$ ; 42%), but very few felt that parenthood should never be considered for female recipients ( $n = 4$ ; 4%). Few had an established policy regarding pregnancy after LuTx ( $n = 23$ ; 22%).

Conditions that respondents considered contraindications to pregnancy in LuTx recipients included nonadherence to medication ( $n = 71$ ; 69%), unstable spirometry ( $n = 63$ ; 61%), a history of antibody-mediated rejection ( $n = 46$ ; 45%), and any stage of chronic lung allograft dysfunction ( $n = 44$ ; 43%). Most respondents stated they would feel comfortable supporting pregnancy in a LuTx recipient with stable spirometry, chronic lung allograft dysfunction grade 0, and who was  $>12$  mo after LuTx ( $n = 55$ ; 73%). With respect to the timing of pregnancy post-LuTx, most respondents favored waiting 1 to 5 y ( $n = 51$ ; 50%), with 26% responding that pregnancy is contraindicated posttransplant ( $n = 27$ ).

Most respondents felt decisions regarding breastfeeding should be deferred to an obstetrician or maternal–fetal medicine specialist ( $n = 37$ ; 66%), with only 18% of respondents believing it is safe and should be encouraged ( $n = 10$ ; 18%).

Most respondents felt there were no contraindications to parenthood for male LuTx recipients ( $N = 59$ ; 59%), but most also recommended that men wait for 1 to 5 y ( $n = 53$ ; 54%).

Thirty-seven percent of respondents cited ethical concerns regarding parenthood after LuTx ( $n = 38$ ). Most concerns are related to the limited life expectancy of the LuTx recipient parent and the consequent impacts on surviving children, partner, or child's surviving carer. The potential impact pregnancy may have on female LuTx recipient graft and patient survival was also cited, as well as concerns for the health of the fetus regarding teratogenicity of medications in the case of recipient pregnancy or ARTs, pregnancy in comorbid recipients conferring risk to the fetus, and potential for transmission of heritable conditions.

### Factors Associated With Provider Attitudes Toward Post-LuTx Parenthood and Pregnancy

Using logistic regression analysis, we attempted to ascertain whether particular respondent characteristics were predictive of specific approaches to fertility, assisted reproduction, pregnancy, and parenthood after LuTx. There was no statistically significant association identified between respondent age, sex, specialty, or professional experience and attitudes or practice patterns.

## DISCUSSION

Survival after LuTx continues to improve, and many LuTx recipients are of, or survive to, child-bearing age. Parenthood and fertility after LuTx are important concerns for many, but there are limited data regarding pregnancy outcomes and the experience of LuTx recipients who pursue parenthood. Although practice patterns and provider attitudes toward pregnancy in heart transplant recipients have been the subject of previous studies, we believe this is the first survey concerning pregnancy and parenthood more broadly in both female and male LuTx recipients.<sup>6</sup> The results indicate a lack of standardization in provider approaches to fertility and parenthood in LuTx recipients and, hence, highlight areas for further policy development.

LuTx differs from other solid organ transplants in ways relevant to decisions regarding fertility and parenthood. Life

expectancy after LuTx is low relative to other solid organ transplants, leaving a shorter reproductive window for LuTx recipients compared with other solid organ transplant recipients.<sup>4</sup> The rate of rejection posttransplantation is higher, necessitating a more aggressive immunosuppression regimen for a longer period.<sup>7</sup> Given the teratogenicity of some immunosuppression, this further limits the opportunity to safely pursue parenthood after transplant. Although retransplantation is possible in the event of graft failure, it is uncommon, and life expectancy is lower after subsequent transplantation.<sup>8</sup> These issues contribute to the complexity of reproductive decision-making around LuTx.

The recently published ISHLT Consensus Statement regarding reproductive health in thoracic transplant recipients makes recommendations regarding proactive preconception and contraceptive planning.<sup>5</sup> About half of pregnancies in LuTx recipients are unplanned.<sup>2,3</sup> Despite this, our survey revealed a lack of uniformity regarding contraception counseling, particularly in male recipients. A minority of respondents advised the use of barrier contraception by male LuTx recipients as part of pregnancy prevention, despite its parallel role in protection against sexually transmitted diseases. The ISHLT Consensus Statement offers reassurance that mycophenolate need not be avoided in nongestational parents, given increasing evidence from other solid organ transplant recipients that usage of mycophenolate and other immunosuppressants by male recipients at the time of conception does not increase the risk of adverse outcomes.<sup>5,9,10</sup> Despite this, almost three-quarters of providers reported always or sometimes informing male recipients that fathering children while taking certain immunosuppression is contraindicated.

There also appears to be a lack of discussion before transplantation about the impacts of transplantation on fertility and consideration of fertility preservation. In addition, less than half of respondents recommended preconception genetic screening for recipients with cystic fibrosis despite the genetic basis of the disease. Most centers have no established policies regarding fertility and parenthood in LuTx recipients, which poses a significant barrier to safe post-LuTx reproduction.

A significant proportion of respondents held ethical concerns relating to LuTx recipients becoming parents. Much of this concern is related to the relatively short projected posttransplant survival of LuTx recipients. Despite this, many providers failed to engage in frank discussions with recipients' partners about the prospect of single parenthood. Although ethical concerns were prevalent, the vast majority of respondents were broadly supportive of LuTx recipients becoming parents. It does not appear that the lack of established policy regarding post-LuTx parenthood represents passive resistance or discouragement on the part of providers but may reflect the historical paucity of evidence and experience in this area.

Post-LuTx survival is improving, and an increasing proportion of young LuTx recipients may choose to pursue parenthood. However, any such increase may be countered by future advances in treatments for cystic fibrosis and pulmonary hypertension, resulting in fewer LuTx performed in these typically young patients. In this way, parenthood after LuTx may remain a relatively uncommon occurrence. Policies and guidelines regarding LuTx recipient fertility and parenthood

need to be formulated on the basis of available evidence and expert opinion to counter inexperience of individual centers.<sup>5</sup>

Evidence regarding parenthood after LuTx is lacking. Registry data collection, such as that of Transplant Pregnancy Registry International, depends on self-identification by transplant recipients, which may select for reports of successful procreation only.<sup>11</sup> Post-LuTx parenthood studies have primarily focused on outcomes of pregnancies in LuTx recipients, with minimal data available relating to parenthood in male recipients. The low numbers of recipient pregnancies reported in the case series may reflect the relatively low opportunity for recipients to become pregnant. Relatively few LuTx are performed in recipients of child-bearing potential compared with other solid organ transplants, which, combined with the limited life expectancy of LuTx recipients, reduces the opportunity for pregnancy after LuTx. Traditional medical opposition to pregnancy after LuTx because of a perception of risk may also affect rates of pregnancy. More rigorous data collection is needed, particularly in the era of newer ARTs to better characterize risk and better inform recipients regarding their options regarding parenthood.

The survey results indicate a need to increase provider education regarding fertility and reproduction after LuTx. Individual knowledge gaps may also be bridged by the development of center-specific pathways to safe parenthood after LuTx, involving discussions and shared decision-making, which commences before transplantation and continues through the post-LuTx period. More data are needed regarding all aspects of LuTx recipient fertility and reproductive health, particularly concerning the experience of recipient of navigating the path to parenthood in the absence of standardized medical guidance.

## LIMITATIONS

Low overall numbers of survey participants may limit the generalizability of the results. The survey was designed to collect demographic data at its conclusion in an attempt to maximize engagement. Despite this, almost one-quarter of respondents completed <50% of the survey (31/144 respondents), and their responses were discounted from the analysis. Although greater response numbers would have made the results more representative, respondents had significant demographic and experiential heterogeneity. Survey responses were anonymous to encourage participation and candor. It is likely that some respondents were from the same transplant centers, which could affect results regarding prevailing practices and policies. The inclusion of transplant providers with nonmedical professional roles may have skewed some responses regarding practices, but responses have been further

analyzed by professional roles. The survey was vulnerable to voluntary response bias, and attempts to minimize potential leading question bias were made through rating agreement scales and free-text response options where appropriate.

## CONCLUSION

Transplant providers were generally supportive of the pursuit of parenthood by LuTx recipients. Though most felt that pregnancy was feasible in some female recipients, almost half believed that alternative avenues to parenthood should be encouraged. There was significant variability in practice with respect to fertility preservation, contraception, and preconception counseling, and a significant lack of center-based policy regarding posttransplant reproduction was evident. Given the lack of data and experience regarding pregnancy and parenthood in LuTx recipients, providers should develop local guidelines in accordance with the best available evidence, outlined in the ISHLT Consensus Statement.<sup>5</sup>

## REFERENCES

1. Gyi KM, Hodson ME, Yacoub MY. Pregnancy in cystic fibrosis lung transplant recipients: case series and review. *J Cyst Fibros.* 2006;5:171–175.
2. Bry C, Hubert D, Reynaud-Gaubert M, et al. Pregnancy after lung and heart-lung transplantation: a French multicentre retrospective study of 39 pregnancies. *ERJ Open Res.* 2019;5:00254–2018.
3. Thakrar MV, Morley K, Lordan JL, et al. Pregnancy after lung and heart-lung transplantation. *J Heart Lung Transplant.* 2014;33:593–598.
4. Chambers DC, Cherikh WS, Harhay MO, et al; International Society for Heart and Lung Transplantation. The International Thoracic Organ Transplant Registry of the International Society for Heart and Lung Transplantation: thirty-sixth adult lung and heart-lung transplantation report—2019; focus theme: donor and recipient size match. *J Heart Lung Transplant.* 2019;38:1042–1055.
5. Kittleson MM, DeFilippis EM, Bhagra CJ, et al. Reproductive health after thoracic transplantation: an ISHLT expert consensus statement. *J Heart Lung Transplant.* 2023;42:e1–e42.
6. DeFilippis EM, Haythe J, Farr MA, et al. Practice patterns surrounding pregnancy after heart transplantation. *Circ Heart Fail.* 2020;13:e006811.
7. Yusen RD, Edwards LB, Kucheryavaya AY, et al. The Registry of the International Society for Heart and Lung Transplantation: thirty-second official adult lung and heart-lung transplantation report—2015; focus theme: early graft failure. *J Heart Lung Transplant.* 2015;34:1264–1277.
8. Wallinder A, Danielsson C, Magnusson J, et al. Outcomes and long-term survival after pulmonary retransplantation: a single-center experience. *Ann Thorac Surg.* 2019;108:1037–1044.
9. Midtvedt K, Bergan S, Reisaeter AV, et al. Exposure to mycophenolate and fatherhood. *Transplantation.* 2017;101:e214–e217.
10. Jones A, Clary MJ, McDermott E, et al. Outcomes of pregnancies fathered by solid-organ transplant recipients exposed to mycophenolic acid products. *Prog Transplant.* 2013;23:153–157.
11. Transplant Pregnancy Registry International. *How to participate.* Available at <https://www.transplantpregnancyregistry.org/participation>. Accessed August 25, 2023.