Part VII: Behavioral economics—A framework for donor organ decision-making in pediatric heart transplantation

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Abbreviations: CMS, Center for Medicare and Medicaid Services; KAS, kidney allocation system; MeSH, Medical Subject Headings; OPTN, Organ Procurement and Transplantation Network; SRTR, Scientific Registry of Transplant Recipients; UNOS, United Network for Organ Sharing.

Abstract
The high discard rate of pediatric donor hearts presents a major challenge for children awaiting heart transplantation. Recent literature identifies several factors that contribute to the disparities in pediatric donor heart usage, including regulatory oversight, the absence of guidelines on pediatric donor heart acceptance, and variation among transplant programs. However, a likely additional contributor to this issue are the behavioral factors influencing transplant team decisions in donor offer scenarios, a topic that has not yet been studied in detail. Behavioral economics and decision psychology provide an excellent foundation for investigating decision-making in the pediatric transplant setting, offering key insights into the behavior of transplant professionals. We conducted a systematic review of published literature in pediatric heart transplant related to behavioral economics and the psychology of decision-making. In this review, we draw on paradigms from these two domains in order to examine how existing aspects of the transplant environment, including regulatory oversight, programmatic variation, and allocation systems, may precipitate potential biases surrounding donor offer decisions. Recognizing how human decision behavior influences donor acceptance is a first step toward improving utilization of potentially viable pediatric donor hearts.

Keywords: behavioral economics, decision psychology, heart transplantation, organ discard rate, pediatric transplant

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1 | INTRODUCTION

Although transplant medicine provides life-saving interventions for individuals with organ failure, the availability of donor organs represents the major limitation to success. Global patient outcomes rely upon responsible stewardship of the available donor organs. Discarding a usable donor organ wastes a valuable scarce resource and undermines the collective welfare of patients on the waiting list. The organ discard rate is particularly pronounced in the domain of pediatric heart transplant: 44% of available donor hearts are discarded in the United States, with troublingly high numbers in other countries as well. This manuscript explores potential explanations for why transplant centers would decline donor hearts with such high frequency, while patients on the waitlist sometimes die prior to receiving a transplant.

Focusing on pediatric hearts specifically, we outline potential explanations for this question using behavioral economics and the psychology of decision-making. These domains offer insight on why human behavior often deviates from rational predictions and illuminate the behavioral factors underlying donor selection decisions. Prior literature has linked principles from behavioral economics to transplant decision-making, including how regulatory performance standards, outcome accountability, and misaligned incentives can lead to risk aversion by transplant programs. We extend previous work by focusing specifically on behavioral economics interpretations of the high donor discard rate. We discuss relevant phenomena from the judgment and decision-making literature that may provide a behavioral account of the high discard rate for transplant organs (see summary in Table 1).

2 | METHODS

A systematic literature search was performed in October 2018 using the MeSH terms “Decision Making” and “Economics, Behavioral.” The authors identified key words, and five separate searches were performed utilizing the PubMed database. A pair of authors was assigned to each of the following categories: allocation factors, programmatic factors, regulatory oversight, global approaches, and behavioral economics and the psychology of decision-making. In addition, a medical reference librarian assisted with the search process. Search criteria included articles that were peer-reviewed (abstracts were not included), published in English, and focused on pediatric transplantation (although relevant articles focused on adult transplantation were included if pediatric data were deemed insufficient). After retrieval of the publications, three authors independently assessed the search results and determined a unified set of papers that were reviewed for inclusion.

3 | REGULATORY OVERSIGHT

The intended purposes of regulatory oversight include promotion of institutional transparency, facilitation of informed consumer choices, recognition of program excellence, and identification of programs with inferior outcomes. In the United States, four organizations function systematically to accomplish these objectives with respect to evaluation of transplant center performance. The SRTR collects and analyzes data on patient and graft outcomes using risk adjustment methods. SRTR then generates center-specific outcome reports made accessible to the public on the SRTR website. In addition, SRTR outcome reports are provided to the other three organizations involved in regulatory oversight. The OPTN uses the SRTR reports to monitor center performance, while the UNOS conducts routine reviews of center performance and investigates centers reported to be non-compliant with OPTN obligations. The CMS uses the SRTR reports to determine program certification for participation in Medicare, and many commercial payors follow CMS’ lead in order to determine eligible or “in-network” programs. Thus, the combination of SRTR metrics with UNOS and CMS oversight fulfills valuable goals in the transplant setting: provision of transparent healthcare information, identification of center practice patterns, and facilitation of improvement efforts in underperforming centers.

Despite the laudable intentions of regulatory oversight, the current performance measures also lead to unintended consequences. Poor performance that is made public incurs significant financial and public relations costs for transplant centers, and programs may be warned, placed on probation, or even closed permanently by UNOS or CMS if they exceed the expected number of transplant complications and graft failure in performance reviews. While outcomes are “risk stratified,” accurately accounting for all risk factors on a truly equitable basis presents a difficult task and current models adjust for only a portion of the risk profile. Given the relative scarcity of donor organs, providers must strike a balance in their risk assessments of donor offers without unduly limiting transplants to higher risk candidates. There is a high likelihood that high-risk transplant candidates are disadvantaged by the regulatory structure given the exclusive focus on post-transplant outcomes. Another unintended consequence of public reporting is the potential stifling of innovation and reluctance by programs to pursue novel interventions that are not accounted for in current risk adjustment methods.

Transparency and oversight are critical tools for transplant administration and clinicians, but both may have unintended consequences at the systems level (payors, networks, populations at risk) and at the provider level (allowing regulatory concerns to affect individual care decisions). Several principles from behavioral economics and decision psychology can add to our understanding of how regulatory criteria impact donor selection decisions. Here, we outline three key behavioral phenomena related to outcomes and the downstream effects of outcome assessments.

3.1 | Incentives

A key tenant of both standard and behavioral economics is that rational decision-makers will respond to incentives, and consequently, behavior often follows the reward structure. Non-optimal behavior
can be the result of incentives that are misaligned with the true goals of the organization. Because transplant programs are evaluated based on their transplant success rates, economics and psychology would predict that programs will engage in strategies that maximize transplant success rates, even at the expense of other outcomes, such as the donor discard rate or time on the waitlist. If marginal donors lead to increased risk, then programs are tacitly incentivized to decline marginal donor heart offers to minimize likelihood of complications and graft failure, even when keeping a patient on the waitlist poses greater risks to the patient.\textsuperscript{14,15} Previous evidence suggests that transplant centers respond to regulatory scrutiny by adopting a more conservative approach to accepting donor heart offers.\textsuperscript{6,9,16}

The goal of transplant medicine, of course, is the long-term survival of transplant candidates. Achieving that goal entails not only that patients survive after receiving a transplant but also that they receive transplants \textit{in time} to survive their time on the waitlist.\textsuperscript{17} Prior work has speculated that the current regulatory system used to monitor transplant program performance is not a neutral method of evaluating both aspects of patient survival because it almost exclusively uses post-transplant morbidity and mortality rates in determining program performance.\textsuperscript{9}

There is some debate in the literature as to whether performance evaluations should focus on outcomes from the point of listing (i.e., candidate outcomes), as a replacement for the current method using recipient outcomes.\textsuperscript{18,19} Such a candidate method of evaluation would still be outcome-based rather than process-based, but it would hold transplant centers accountable for all outcomes experienced by a patient after listing for a transplant—both waitlist outcomes and transplant outcomes. This method of evaluation would incentivize programs to employ strategies that trade-off wait time with transplant success. One risk of such an evaluation rubric, however, is that achieving good outcomes for both wait time and transplant survival could be facilitated by declining to list high-risk recipients. Thus, the issue of conservative donor selection may simply be replaced by an issue of more conservative criteria for deciding whether to list high-risk candidates.

### 3.2 Omission bias

Given that regulatory bodies primarily consider post-transplant outcome measures when auditing transplant programs,\textsuperscript{6,9} the consequences for a program of a transplant mortality event are actually objectively worse than those of a waitlist death that could have been prevented by accepting an offered organ. Behavioral economics suggests, however, that centers may be more concerned with transplant success than with waitlist time even if regulatory evaluations assessed both waitlist and transplant outcomes. Specifically, individuals tend to judge harmful commissions as worse than harmful omissions even when outcome severity, information, and actor’s intention are held constant between the two. The basis for this distinction is that harmful omissions are not viewed as causing the outcome, but harmful commissions are. Donor selection decisions offer an example: Accepting an organ for transplant leads to an outcome of commission, while declining a donor organ leads to an outcome of omission. Patients who receive a transplant and patients who remain on the waitlist both face potential mortality, but the act of accepting an offer that leads to a post-transplant death is seen as a worse choice than failing to accept an offer that would have prevented a waitlist death. In this sense, the outcome of a waitlist death
is not regarded as the counterfactual of accepting the transplant, but rather the status-quo alternative.\textsuperscript{20,21}

A potential explanation for omission bias is loss aversion: the fact that losses are weighed more heavily than gains of the same magnitude. Declining a heart that could have been transplanted corresponds to a foregone gain, whereas accepting a heart that leads to post-transplant death corresponds to a loss. A loss would be weighed more heavily than the foregone gain, so the omission would be considered worse than the omission. Omission bias may be enhanced by delayed consequences. Specifically, a patient mortality that occurs months after transplant will likely be attributed to a complication from the transplant despite the delay. In contrast, a waitlist death that occurs months after turning down an available heart may not be attributed to declining the potential transplant. Some centers have attempted to increase transparency of donor acceptance practices by establishing a practice of retrospective review for all donor offers.\textsuperscript{17} The accountability entailed by reviewing any declines of donor offers that preceded a waitlist death could help to offset omission bias.

3.3 | Outcome bias

Even under an optimal incentive system, evaluation of decision quality is challenging. Decision research distinguishes between a good decision and a good outcome. Good decisions are more likely to lead to good outcomes than bad decisions, and thus, outcomes provide a proxy for decision quality when the decision process is unknown. Outcomes, however, are affected by factors other than decision quality, such as luck or random variation. Consequently, good decisions can result in bad outcomes by chance. Therefore, outcome-based measures of accountability, such as the current regulatory criteria, may over-interpret variation in outcomes as reflecting differences in decision quality. A small number of transplant mortality events may simply reflect the risk and uncertainty entailed with well-reasoned decisions to proceed with surgery. If transplant centers know they will be evaluated based on their surgical outcomes, rather than their decision process, they will be motivated to avoid bad outcomes, even if that entails using a sub-optimal decision process (eg, an excessively conservative approach that results in many unused organs). This problem is exacerbated in settings that have low volumes of procedures and small numbers of events, both of which elevate the significance of random variation. Pediatric heart transplantation is characterized by both of these traits.

An accountability system based on the quality of the decision process, rather than outcomes, would reward programs based on the soundness of the procedure used to arrive at the decision to accept or reject a donor organ rather than for the resulting outcome. The main benefit of this method is that centers are incentivized to utilize valid donor selection procedures even though such procedures will inevitably result in occasional poor outcomes. Consequently, centers would be encouraged to accept usable marginal donors and to decline donors who are below a given threshold. Organ quality assessment tools offer potential process-based systems that programs can use to evaluate and standardize their donor quality assessment practices. For instance, kidney transplantation has developed such a tool to address high kidney discard rates; the KAS requires programs to follow standardized protocols detailing the process of reviewing, reporting, and updating candidates’ status changes and their respective donor acceptance criteria. KAS has already demonstrated the positive impact of a donor risk score system on utilization and transplantation for difficult-to-match patients.\textsuperscript{22}

Such an evaluation system would be challenging to devise in the pediatric heart setting, however, as it would require consensus on how to assess donor quality. Evaluating donor hearts is inherently uncertain due to limited ability to accurately assess both clinical and statistical risk.\textsuperscript{18,23} The difficulty in accurately measuring donor risk is especially relevant when considerable heterogeneity exists among patients being considered for transplantation. Therefore, centers may well take into account the public relations and potential financial implications of accepting donors that may have inferior post-transplant outcomes. A recent anonymous survey of pediatric heart transplant specialists found that 48\% of providers explicitly acknowledged that their concerns about regulatory bodies could affect donor acceptance decisions.\textsuperscript{24}

4 | ALLOCATION SYSTEMS AND PROGRAMMATIC FACTORS

Allocation systems such as UNOS and OPTN operate to achieve the equitable distribution of organs. Globally, transplant organ allocation systems share similar ethical goals, but the manner in which systems have developed across countries is highly variable. The potential impact of decision psychology on donor organ assessment interacts with features of these allocation systems, including how organs are offered to subsequent programs after an initial program declines, and how the data are presented to the personnel making donor offer decisions.

In addition, features of specific transplant programs may influence whether a donor offer is accepted or rejected. Even within the United States, geographic regions in the UNOS system exhibit different applications of listing criteria,\textsuperscript{25,26} variation in waitlist times,\textsuperscript{27,28} differences in rates of donor recruitment and donor utilization,\textsuperscript{29-31} and donor anticipated ischemic time for donors.\textsuperscript{32} Programmatic factors such as center transplant volume may be associated with different levels of risk tolerance across programs with respect to acceptable donor quality standards. Given the complexity of pediatric heart transplantation, center resource availability including the surgical team, operative staff, and operating facilities all likely play a role in donor decisions.

Principles from behavioral economics suggest that many of these factors are affected by systematic decision processes that may contribute to the inefficient utilization of pediatric heart donors. Here, we apply these principles in order to address the biases and limitations of current allocation systems and programmatic variation in donor selection practices.
4.1 | Risk aversion

The tendency to decline marginal donors can be explained in terms of risk aversion. Previous literature has analyzed the role of risk aversion in transplant decision-making. If keeping a patient on the waitlist provides a known outcome while transplantsing a marginal organ leads to the uncertainty of a possible better outcome (transplant success) or worse outcome (transplant complication), a risk-averse center may choose to keep the patient on the waitlist in order to minimize the downside risk, even if the overall weighted outcomes for transplantation are superior.

Accepting a heart carries an acute risk of a transplant mortality event, compared to the more chronic risk of a waitlist death entailed by declining a heart. A transplant situation where most patients are expected to survive implies that the impact of a single mortality is greater than the impact of a single additional patient surviving. Donor offer decisions may also be impacted by recent programmatic mortalities, as such an event makes providers less willing to subsequently accept a marginal donor organ. Smaller centers would have a reason to be more risk-averse than large centers in that a single mortality event has a larger effect on the success statistics for a small number of patients than for a large number (e.g., a single mortality event could change the success rate from 3/4 to 3/5, which is a larger percentage change than from 15/20 to 15/21). Recent survey findings suggest that small volume programs consider the risk of programmatic restrictions more frequently when deciding to accept a marginal-quality donor, while a retrospective analysis of UNOS data suggests a correlation between listing at a low volume center and inferior waitlist outcomes.

Centers vary intrinsically in their thresholds to accept and list high-risk transplant candidates. There is also variability in risk tolerance across centers with regard to proceeding with transplantation. If programs decline usable organs because of risk aversion, information presentation strategies could be used that encourage risk tolerance. For example, decision research shows that decision-makers are more risk-seeking when the two options are framed as losses rather than as gains. Recent data suggest that there is no accepted approach to transplantation in highly sensitized recipients, and the requirement of a negative prospective crossmatch in this group has been demonstrated to result in longer waitlist times and inferior outcomes following listing. Decision model analysis in this group favors acceptance of the first available organ regardless of sensitization, although there may be some recipients who can safely wait for and ideally matched donor. Similarly, a recent multicenter study demonstrated no difference in a composite end-point at 1 year for those transplanted with or without a positive complement-dependent cytotoxic crossmatch although the numbers in the crossmatch positive arm were small. Despite this, there remains significant variability among centers in their willingness to transplant in the face of a positive crossmatch and utilization of prospective crossmatching.

4.2 | Information cascades

The current protocol for donor match sequences under the UNOS allocation system may allow one transplant program to influence the decisions of programs further down the offer list. Because the quality and acceptability of a particular donor may be uncertain, the personnel making the acceptance decisions may rely on contextual cues when making their judgment and imitate the denial behavior of previous decision-makers. Plainly stated, if four previous centers have declined a donor, the fifth center may conclude that the donor quality must be low. This process of attending to the behavior of others is known as “information cascade.” In the United States, providers are able to see the decisions made by the centers that have already been offered a particular donor organ, including their reason for making that decision. The decisions and rationale from previous programs provide information to subsequent centers but also have the potential to bias centers further down the list: Centers may tend to mimic the decision of the first center even in the face of an otherwise acceptable organ. This behavior also implies that any misstatement of the reason for making a decision to decline a donor (i.e., the program cites “organ quality” as the decision rationale rather than the real reason such as surgeon unavailability) may create unwarranted apprehension in centers evaluating the donor heart later in the match run. A recent analysis of adult lung transplant recipients demonstrates initial evidence for this bias: The number of donor quality-related refusal codes assigned to organs that were ultimately accepted for transplant was not associated with post-transplant survival outcomes in recipients. Moreover, the number of refusals due to poor organ quality did in fact predict donor lung utilization, which suggests that centers may consider donor offers in the context of previous refusal rationales.

The allocation system used in Spain employs a protocol that discourages information cascades. Specifically, there are ramifications for rejecting a donor organ that is accepted by another program. For example, if a team rejects a heart offer and the following team in the list performs the transplant, the first team will be demoted to last priority position for the next available donor. The only accepted reasons for not demoting the team are donor recipient sizing incompatibility, if the team is performing another transplant at the time, or if the recipient in question is listed at the highest status (code 0 or 1). In this way, teams are incentivized to comply with the consensus criteria, and marginal donors must be taken into consideration by all teams. The UK, where only two centers actively perform pediatric heart transplants, provides another example of an allocation system that circumvents information cascades. The two UK transplant centers alternate priority for receiving a donor organ, but decisions made on any potential donor organ are impossible to hide, given that only two centers are involved. Further, the centers are able to discuss cases as they arise, which allows for taking turns “out of order” if needed for a specific patient’s situation.
4.3 Information presentation

Although all transplant programs of a given type in the same country are subject to the same programmatic evaluation criteria, they may differ in the strategies they employ to bring their performance in line with the criteria. In particular, programs can use a selective or open strategy when accepting donors. A transplant center can attempt to enhance its reported transplant success rate by being highly selective in accepting donor organs, taking only the highest quality organs and declining the rest, with the presumption that high-quality donors contribute to transplant success. Under this selective strategy, the high transplant success rate will be at the expense of performing fewer transplants, and therefore, patients will on average wait longer for a transplant and the number who die while waiting will increase. Alternatively, a transplant center can employ an open acceptance strategy, using most organs offered (including marginal organs) and thus decrease wait time. To the extent that marginal organs result in poorer surgical outcomes, however, the transplant success rate will decline. If centers were not penalized (by regulatory bodies) for accepting a marginal donor, acceptance of these hearts would increase. Therefore, generating a classification scheme for donors as marginal or not and allowing this classification to be adjusted for in the SRTR risk adjustment models may decrease the negative impact of regulatory oversight when it comes to marginal donors.

How centers make this trade-off between wait time and transplant success rate may depend on what information is presented for evaluation and how that information is presented. When centers must present information on their transplant success rate only, they are incentivized to be selective in accepting hearts, increasing the decline rate. If outcomes are presented in a more complete manner, however, centers may be encouraged to use a more open strategy. To illustrate this concept, consider two hypothetical transplant centers described in Figure 1. Each center manages 30 potential recipients in a given year, and each center is offered 10 excellent and 10 marginal organs that they may accept or decline. Center A is less selective in accepting donor organs than Center B. The particular numbers in Figure 1 reflect an illustrative assumption that patients are most likely to survive if transplanted with an excellent organ and least likely to survive if they remain on the waitlist, with survival following transplantation with a marginal organ falling in between. Note that while this assumption (regarding the pattern in survival rates) is not supported in the literature, it is a commonly held view by transplant professionals.

In the table, Center A has better patient outcomes than Center B in every column: survival after transplant with an excellent donor organ, survival after transplant with a marginal donor organ, and survival on the waitlist. Consider evaluation of the centers under three different methods to present the information. Report Card X evaluates centers based on their total transplant survival (percentage of survivors out of all patients who were transplanted), which makes Center B look better than Center A. In contrast, Report Card Y shows transplant survival stratified by donor risk level. This presentation reveals that Center A performs better than Center B with both excellent and marginal organs and that the reason Center A has a worse overall transplant success rate is that they transplanted more marginal organs, and marginal organs may lead to worse outcomes than excellent organs do. Finally, Report Card Z shows total survival rates across all 30 patients in each center (combining those transplanted with those on the waitlist), resulting in a better score for Center A.

<table>
<thead>
<tr>
<th>Transplant Center</th>
<th>1-year survival following transplant with an excellent organ</th>
<th>1-year survival following transplant with a marginal organ</th>
<th>1-year survival for patients who remain on the waitlist (no transplant)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Center A</td>
<td>10 out of 10 (100%)</td>
<td>6 out of 10 (60%)</td>
<td>4 out of 10 (40%)</td>
</tr>
<tr>
<td>Center B</td>
<td>9 out of 10 (90%)</td>
<td>1 out of 2 (50%)</td>
<td>4 out of 18 (22%)</td>
</tr>
</tbody>
</table>

**FIGURE 1** Performance of two hypothetical transplant centers, each having 30 listed patients, described in terms of 1-y survival following transplant with an excellent organ, 1-y survival following transplant with a marginal organ, and 1-y survival for patients who did not receive a transplant but remain on the waitlist. Whereas Report Card X (transplant survival combined across excellent and marginal donors) shows better performance for Center B, Report Card Y (transplant survival stratified by excellent and marginal donors) and Report Card Z (total survival summing across both transplant recipients and waitlist patients) show better performance for Center A.
Center B boosts its overall transplant success (Report Card X) rate via selectivity; accepting many excellent but few marginal hearts. This selectivity results in more patients remaining on the waitlist, and it thus decreases total survival (Report Card Z) because patients who receive marginal organs have better outcomes than for those who remain on the waitlist. Center A, in contrast, uses an open strategy and accepts all marginal organs.

If Center A knows that it will be evaluated in terms of total survival rate (Report Card Z) or in terms of transplant success stratified by donor risk level (Report Card Y), it will be incentivized to continue accepting a high percentage of marginal organs. This example illustrates the classic Simpson's paradox which in previous work has been linked to the issue of adjusting outcomes data for patient mix.40

5 | DISCUSSION

Decision-making surrounding the acceptance of donor organs is complex and influenced by multiple factors in the choice environment and in the psychology of the decision-maker. Behavioral economics provides an illuminating foundation for examining the decision-making process, providing key insights into the behavior of transplant professionals. Influences on decision-making include both features of the choice environment and features of the decision-maker. For example, the current transplant regulatory environment evaluates programs principally based on transplant outcomes, not waitlist outcomes. Therefore, decision-makers may make choices (eg, selectively declining organ offers) that fit the incentive scheme but not the larger organizational goals. In addition, the psychology of individual decision-makers within programs may be characterized by risk aversion or the tendency to treat omissions differently from commissions.

Understanding the economic and psychological factors that affect decisions to accept or decline organs can illuminate strategies for increasing access to scarce transplant organs and decreasing wait time while continuing to foster transplant success. Given the current incentive scheme in place, it is likely that some change to the allocation or oversight for marginal donors will be required to increase usage of donors. In order to address outcome bias, a regulatory system that evaluated decision process, rather than outcomes, could be introduced. To counteract the tendency to treat adverse outcomes from commission as worse than identical outcomes from omission, the choice to decline an organ could be presented as an active choice with consequences rather than as a passive failure to choose. If organs are declined because of risk aversion, information presentation strategies could make clear the risks entailed by keeping a patient on the waitlist. Information cascade effects could be reduced if programs were not informed about the number of previous programs who had declined an organ before the offer was made. Finally, the effect of information presentation could be harnessed if program statistics were presented stratified by donor risk level so that programs that accept a large number of marginal organs would not be penalized for a drop in their overall transplant success figures.

Although good transplant decision-making requires clinical expertise and benefits from medical advances, improving decisions about stewardship of scarce resources requires insights from behavioral science.

AUTHOR CONTRIBUTIONS

All authors (Drs. Davies, Dipchand, Miera, Kirk, Butler, Chapman, Johnson, Amodeo, Bohmer, Camino, Godown, Perez-Blanco, Rosenthal, and Zangwill) conceptualized the study concept, and drafted, critically reviewed, and revised the manuscript for important clinical and intellectual content.

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