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Editorial Open Access

The Impact of Market Forces on Liver Transplant Allocation

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Abbreviations:

DSA: Donor Service Area; OPO: Organ Procurement Organization

Editorial

Under the current liver organ allocation system organs are on a sickest first policy as prioritized by MELD score within one of the 11 multi-state UNOS regions for MELD scores greater than 35. In the unusual circumstance in which no patient has a MELD score above 35, the organ is offered within a local area, again prioritized by the MELD score. Both UNOS regions and local distribution areas called DSAs (Donor Service Areas) may be served by several transplant centers creating a competitive environment for organ placement primarily between transplant centers acting as proxy for their listed patients. Although donor livers are offered for recipients based solely on urgency as defined by the MELD score, centers and patients are free to accept or reject offers based on their personal estimate for successful transplantation.

Simply put, transplant centers either obtain organs for their patients by tolerating maximal disease severity for their listed patients or accepting higher risk donor organs that are rejected by competing centers. In order to avoid losing organs to competitor programs, transplant centers maintain large lists of potential transplant recipients and are pressured to transplant recipients at the extremes of liver disease when their MELD score is highest and more likely to "win the allocation." Unless there are unusual circumstances, low risk organs will generally be accepted for the first patient for whom the organ is offered (highest MELD). Higher risk donor liver offers are often refused for the highest MELD patients on the list based on the cumulative estimated risk for the particular donor/recipient pair.

To better understand the behavior that results when many centers are involved in matching for the same donor organ one can use an auction analogy in which recipients bid for organs by paying not with money but rather with estimated risk for mortality as determined by the combination of donor and recipient risk factors. Essentially, the donor offer has now become a auction in which the winning bidder is the one who has the most optimistic valuation of risk for a particular donor/recipient pairing. This is similar to what economists describe as a "common value auction" in which bidders value the bid item similarly, but do not have information regarding the true value of the item. Common value auctions are characterized by the "winner's curse" which states that since the winner is the person who estimates the highest value for the bid item, the winner will likely overpay [1]. For our analogy, the bid item is the donor liver, the bidders all have their own valuation based on their personal estimate of mortality risk for that donor/recipient combination and the true value is the actual mortality of the combination. In terms relevant to transplantation, the winner, who nevertheless may benefit from the transplant, is cursed by accepting excessive risk either by transplantation at a stage of excessively advanced disease or by accepting an excessive risk donor organ.

The evidence for the influence of the winner's curse in transplant allocation is best illustrated by the impact of competition worsening survival in liver transplantation [2]. Under the current liver organ allocation system organs are placed locally (within a donor service area, DSA) as prioritized by MELD. If the organ is not accepted locally, it is next offered within the UNOS multi-state region in which the organ donor resides. If the organ is not placed regionally, it is offered nationally. Traditionally, some DSA's are served by a single transplant center and some by multiple centers allowing study of a natural experiment on the effect of competition on liver transplant practice patterns. It is the dramatic difference in practice patterns between single and multiple center DSA's that best demonstrates the influences of the auction effect on organ placement [2,3]. DSAs with multiple competing centers transplant at higher average MELD score, are more willing to list high risk recipients, accept higher risk organs and often adopt aggressive strategies to increase the size of the donor pool (e.g. living donor and split liver transplantation). In contrast, single center DSAs gain minimal advantage from transplanting very sick recipients. They have shorter waiting lists, transplant patients at lower average MELD and given less competition for organs, may be more likely to transplant higher risk organs into low MELD recipients.

Ineffective donor/recipient matching results in not only poorer survival but increased cost from both worse post-transplant outcomes and increased costs pre-transplant as the co-morbidities of liver failure progress. Increased costs create significant financial risk for transplant centers and more importantly, limit access to transplantation and equity of allocation since patients require high transplant insurance caps in order to qualify for listing [4-6].

In order to improve allocation efficiency, it is inherent to address the underlying behavioral patterns contributing to the inefficiencies. Understanding organ allocation as an auction model gives new insights into the adaptive behaviors that occur when allocation rule changes are modified. For example, it has been suggested that abolishing the local organ distribution model by establishing a national list for liver allocation would help alleviate organ shortages by redistributing livers to regions where they are most needed as evidenced by large waiting lists and high average MELD. Using the auction analogy, we hypothesize that such an allocation change might have an effect less than intended since a national list would increase the number of bidders and increase the likelihood of overly optimistic risk estimates therefore amplifying the "winner's curse." Single center DSA's which previously were able to practice by managing risk conservatively would be forced to join the bidding and would adapt to

the potential loss of organs by increasing risk as reflected by listing more patients and accepting higher risk donors. Aggressive centers in multicenter DSA's used to bidding locally would now bid against the most aggressive centers on a national level and would increase their risk accordingly or be unable to obtain organs for their listed patients. The result would be an allocation policy of "maximum tolerated risk" rather than "optimal donor/recipient match."

Importantly, despite these inefficiencies, we do not feel the current MELD based allocation system is broken. Urgency based allocation based on MELD is simple, objective, accurate, reliable and understood by all stakeholders. Furthermore, we do not advocate elimination of competition between centers. Harnessed properly, competition, as is seen in multi-center DSAs can be an effective driving force for innovation and quality improvement.

We recommend an alternative solution. Understanding the behavioral dynamics that underlie allocation practice allows the primary driver to be addressed. The real solution to eliminating the "winners curse" is removing the reward for overly optimistic risk assessment during organ placement. In auction theory, alternative auction models can be designed to negate the impact of the "winners curse" by changing the criteria for valuation of the bid item. As applied to transplantation, auction models can be modified to ensure that pressures to accept excessive risk are minimized. Objective estimates of the outcome of donor/recipient pairing are readily available. A number of predictive models for mortality risk between particular donor/recipient combinations have now been described [7-9]. Using modeling, unacceptable risk combinations can be bypassed so that donor offers are only made at a level of risk deemed appropriate by the community [10]. Using the auction analogy, the bidding would be limited to a predetermined maximum level and the "winners curse" would be decreased since risk determinations would be prevented from excessive optimism. Rather than being rewarded for excessive risk taking, centers would focus on transplanting at the most opportune time when the benefit of transplant is optimal rather than accumulating the sickest patients in order to compete for organs successfully. Such a system would also address the issue of excessive high donor risk for low MELD recipients by barring matches for patients not meeting a minimal survival benefit bar and redistributing organs to recipients in which the risk/benefit ratio is optimal.

Finally, although centers may obtain the organs, they are only acting as a proxy representing potential recipients who bear the most significant consequences of matching decisions. It is vitally important that allocation systems do not contain conflicting interests between center and patient. Establishment of community standards for acceptable risk caps in donor/recipient matching could help reduce inherent some counterproductive tendencies currently unaddressed within the current allocation system.

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