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## **Going the Distance for Procurement of Donation after Circulatory Death Livers for Transplantation – Does Reimbursement Reflect Reality?**

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Running head: DCD travel costs

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## Going the Distance for Procurement of Donation after Circulatory Death Livers for Transplantation – Does Reimbursement Reflect Reality?

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*Clin Transplant*

Abstract: Donation after circulatory death (DCD) liver transplantation (LT) has increased slowly over the past decade. Given that transplant surgeons generally determine liver offer acceptance, understanding surgeon incentives and disincentives is paramount. The purpose of this study was to assess aggregate travel distance per successful DCD versus deceased after brain death (DBD) liver procurement as a surrogate for surgeon time expenditure and opportunity cost. All consecutive liver offers made to Michigan Medicine from 2006-2017 were analyzed. Primary outcome was the summative travel distance (spent on all attempted procurements) per successful liver procurement that resulted in LT. DCD liver offer acceptance was lower than DBD liver offers, as was successful procurement among accepted offers. Overall, 10,275 miles were travelled for accepted DCD liver offers, resulting in 23 successful procurements (mean 447 miles per successful DCD liver procurement). For accepted DBD liver offers, 197,299 miles were travelled, resulting in 863 successful procurements (mean 229 miles per successful DBD liver procurement). On average, each successful DCD liver procurement required 218 more miles of travel than each successful DBD liver procurement. Current reimbursement policies poorly reflect increased surgeon travel (and time) expenditures between DCD and DBD liver offers.

Keywords: Liver, Donation, Deceased After Circulatory Death, Deceased After Brain Death, Reimbursement, Travel

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## Introduction

Donation after circulatory death (DCD) liver transplantation (LT) has increased slowly in the U.S. over the past decade, from 409 transplants in 2008 to 764 in 2018<sup>1</sup>. In part, this modest growth may be due to increased surgeon and center resource utilization for DCD LT compared to donation after brain death (DBD) LT, including lower procurement rates for DCD donors and higher center costs per successful procurement<sup>2</sup>. Given that transplant surgeons generally determine liver offer acceptance, understanding surgeon incentives and disincentives is paramount. One variable that might influence surgeon decision making is the increased time commitment required for each DCD liver procurement, a surrogate measure of the opportunity costs of pursuing these types of liver donors. Accordingly, we performed a center-level analysis of aggregate travel distance per successful DCD liver procurement compared to DBD liver procurement.

## Patients and Methods

All consecutive liver offers made to Michigan Medicine from 2006–2017 were identified. Primary exposure was donor type (DBD or DCD). Primary outcome was the summative travel distance per successful liver procurement that resulted in LT. This was calculated by summing the total round-trip travel distances expended by donor type and dividing by the ultimate number of successful LTs. Secondary outcomes were liver offer acceptance and successful procurement proportion, and mode of transportation (ground versus flight). Wilcoxon rank sum and  $\chi^2$ -test were used to compare groups; significance was set at  $P < 0.05$ . Analyses were performed using STATA 15.1. This study was deemed exempt by the Michigan Medicine Institutional Review Board.

## Results

During the study period, a total of 3,348 potential liver offers were received by our center. Of these, 3,039 (90.8%) were DBD and 309 (9.2%) were DCD. Liver offer acceptance was significantly lower for DCD ( $n=48/309$ , 15.5%) than DBD ( $n=935/3,039$ , 30.8%) liver offers ( $P < .001$ ) [Table]. After a procurement team was dispatched, successful procurement was significantly lower for DCD ( $n=23/48$ , 47.9%) than DBD ( $n=863/935$ , 92.3%) liver donors ( $P < .001$ ). Among accepted offers, including offers that

did not result in successful procurement, median distance travelled was 110 miles (IQR 72-264 miles) for DCD livers and 126 miles (IQR 86-264 miles) for DBD livers ( $P=.27$ ). Proportion of air travel was not significantly different between the accepted DCD and DBD liver offers. Overall, 10,275 miles were travelled for accepted DCD liver offers and 197,299 miles were travelled for accepted DBD liver offers. This resulted in a mean 447 miles per successful DCD liver procurement and 229 miles per successful DBD liver procurement, a difference of 218 miles per successful liver procurement ( $P<.001$ ).

## **Discussion**

On average, each successful DCD liver procurement required 218 more miles of travel than each successful DBD liver procurement. This difference was largely due to lower successful procurement proportion among DCD procurement episodes. Only 49.7% of DCD liver offers resulted in a liver procured for transplant, compared with 92.3% of DBD offers. Longer distances to travel suggest increasing surgeon time expenditure per successful DCD liver procurement.

Increasing distance and requisite time expenditures among DCD procurements may act as disincentives to DCD liver offer acceptance among transplant surgeons. This surgeon time and opportunity cost is compounded by increased costs to the transplant center for transportation, personnel, and recipient admissions during unsuccessful procurements that do not ultimately generate revenue via transplant reimbursement<sup>2</sup>.

Current compensation models poorly reflect the increased costs associated with lower successful procurement proportion among accepted DCD liver offers. In general, successful organ procurements are compensated at significantly-higher levels than unsuccessful procurements. For instance, Michigan Medicine is given \$4,000 per successful liver procurement from our OPO, but only \$1,250 if unsuccessful. While this might be appropriate for DBD liver offers that have a high likelihood of success, this strategy might not be appropriate for DCD liver offers and further deter DCD offer acceptance. Additional work is needed to align surgeon/center costs and reimbursements with the increased resources expended for each successful DCD LT.

This may include negotiating better stand-by surgeons' fees from OPOs or working with hospitals to create a pre-admission unit which is free for patients on "standby" waiting for a DCD liver offer.

This study is limited by its retrospective nature and generalizability as a single-center study. Donor characteristics and their effects on liver offer acceptance are unknown, as are the dispositions of other organs during procurement episodes. Nonetheless, our findings support the growing evidence of increased surgeon and center resource utilization during DCD liver procurements. Implementation of compensation models that adjust for lower successful procurement proportion and increased nonmonetary costs of DCD liver procurements must be addressed to support expansion of DCD LT. Further research is needed to characterize surgeons decision-making regarding DCD liver offer acceptance or refusal.

### **Author Contributions**

John Montgomery contributed to concept/design, data analysis/interpretation, statistics, drafting article, critical revision of article, and approval of article. Alexandra Hight contributed to drafting article, critical revision of article, and approval of article. Michael Englesbe contributed to concept/design, critical revision of article, and approval of article. Mark Hobeika contributed to concept/design, critical revision of article, and approval of article. Lisa McElroy contributed to concept/design, data analysis/interpretation, drafting article, critical revision of article, and approval of article.

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	<b>DCD liver offer (n=309)</b>	<b>DBD liver offer (n=3,039)</b>	<b>P value</b>
Offer acceptance, n (%)	48/309 (15.5)	935/3,039 (30.8)	<.001
Successful procurement, n (%) <sup>a</sup>	23/48 (47.9)	863/935 (92.3)	<.001
Distance travelled per accepted offer, median (IQR), miles	110 (72, 264)	126 (86, 264)	.27
Air travel, n (%)	19/48 (39.6)	314/935 (33.6)	.39
Aggregate distance travelled, miles	10,275	197,299	N/A
Aggregate travel distance per successful procurement, miles <sup>b</sup>	447	229	<.001

*Table.* Outcomes of DCD and DBD liver offers at Michigan Medicine, 2006-2017.

<sup>a</sup> Percentage represents proportion of successful procurements after offer acceptance.

<sup>b</sup> Computed by aggregate travel distance divided by the total number of livers successfully procured, by donor type. For DCD livers, this equates to 10,275 miles divided by 23 successful procurements = 447 miles travelled per successful procurement. For DBD livers, this equates to 197,299 miles divided by 863 successful procurements = 229 miles travelled per successful procurement.

Abbreviations: IQR, interquartile range; DCD, deceased after circulatory death; DBD, deceased after brain death.