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Research Paper

The effects of demographic, psychosocial, and socioeconomic characteristics on access to heart transplantation and left ventricular assist device[☆]

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ABSTRACT

Background: This study aims to better understand how demographic, psychosocial, and socioeconomic factors influence the selection of patients for advanced therapies for heart failure (heart transplant and left ventricular assist device (LVAD)).

Methods: Patients evaluated for heart transplant or LVAD at a large, Midwestern hospital system were assessed retrospectively. Three outcomes were analyzed: 1) Patients who were evaluated and approved to receive a transplant or LVAD were compared to patients who were not approved for transplant or LVAD; 2) Patients who were listed for transplant were compared to patients not listed; and 3) Patients who received a transplant or LVAD were compared to patients who did not receive a transplant or LVAD. ANOVA was used for continuous variables and Chi-squared test for categorical variables. Significant variables were further analyzed by logistic regression.

Results: Four hundred fifty-nine patients were included. Marital status ($p = 0.004$), race ($p = 0.008$), social support ($p < 0.001$), mental health ($p = 0.006$), and substance use ($p < 0.001$) were associated with whether patients were approved for transplant or LVAD. Patients with public insurance were half as likely (OR 0.495) to be listed for transplant once approved.

Conclusions: Financial, psychosocial, and demographic characteristics all play a role in selection for advanced therapies for heart failure. These insights can help guide future work on interventions to address the social disparities in access to heart transplant and LVAD.

1. Introduction

Heart failure is a major public health problem. Heart disease in general has been on the decline in recent years, in large part to increased prevention efforts [1]. However, the prevalence of heart failure is expected to continue to rise and remain a serious health burden, largely due to the increasing aging population [2,3]. It was estimated 6.5 million adults in the U.S. had heart failure as of 2017 [4].

Despite advances in modern therapies, the 5-year mortality rate remains >50 % for patients diagnosed with heart failure [50]. It is estimated that 10 % of heart failure patients have advanced heart failure (AHF), which is defined as heart failure refractory to standard

treatments and which might require advanced therapies [5]. Cardiac transplantation remains the gold standard treatment for patients with AHF with durable left ventricular assist devices (LVADs) serving as an option as a bridge-to-transplant or as an alternative therapy for those who do not qualify for transplant. In 2018, there were 3408 heart transplantations in the U.S. [6] and over 2500 LVADs are implanted in the U.S. per year [7].

A donated heart is a life-saving gift based upon the generosity of organ donors as well as a limited resource with inherent restrictions on availability and access. Due to organ scarcity, the substantial lifelong medical management that both heart transplantation and LVAD implantation require, and the medical and surgical risks involved in either

Abbreviations: AHF, advanced heart failure; LVAD, left ventricular assist device; SW, social worker.

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treatment, there is an extensive selection process for both interventions. Selection of appropriate candidates involves evaluations by a multidisciplinary team of transplant professionals, including medical, psychosocial, and financial evaluations to ensure that the patient has appropriate resources and ability to adhere to the lifelong treatment regimen necessary for a good outcome.

Variables that may play a role in selection were evaluated in this study. Age, sex, race, and marital status were chosen due to being commonly used in epidemiological research. Substance use, social support, mental health, legal history, cognitive impairment, and insurance status were evaluated due to being key elements of the evaluation process at our institution as well as being noted recommendations in the literature for evaluation in cardiothoracic transplant and circulatory support candidates [17].

Most research on eligibility for advanced therapies has focused on the characteristics of *recipients* of either heart transplant or LVAD, but less is known about the patients undergoing the *selection* process for eligibility. From the limited research available, patients with Medicare and Medicaid insurance were less likely to be eligible for heart transplantation compared to the privately insured [13], and a national survey revealed 48 % of heart transplant programs require adequate insurance coverage before evaluation and 84 % of programs require coverage before listing for transplantation [11]. Additional information is needed to understand the characteristics of patients undergoing the selection process for heart transplant and LVAD.

The aim of this study is to better understand the populations denied approval or access to healthcare. This research investigated demographic, psychosocial, and socioeconomic factors influencing a patient's eligibility and approval for advanced therapies and assessed the strength of any such associations. The authors proposed that such characteristics may affect whether patients are selected for or receive heart transplant or LVAD interventions. This research will identify which variables, among age, race, sex, marital status, substance use, social support, mental health, legal history, cognitive impairment, and insurance status, affect whether patients are selected for or receive treatment, as well as the strength of such variables on selection, heart transplantation, and/or LVAD implantation.

2. Methods

2.1. Approach

This was a retrospective chart review at a large, Midwest hospital between November 2010 and December 2019 investigating how demographic, psychosocial, and socioeconomic factors influence the selection of patients for advanced therapies (heart transplant and LVAD). Three outcomes were assessed: 1) Patients who were evaluated and approved to receive a heart transplant or LVAD were compared to the patients who did not receive approval; 2) Patients who were listed for transplant were compared to patients not listed; and 3) Patients who received advanced therapies were compared to patients who did not receive advanced therapies.

2.2. Patients

All adult patients who underwent an AHF evaluation at Spectrum Health were eligible for this research. The time frame of November 2010 through December 2019 was chosen to align with the start of the heart transplant program at Spectrum Health and IRB approval of this research. To be included, documentation of the AHF evaluation must have been present within the patient's electronic medical record (EMR). The study received a waiver of informed consent and dual approval by the Spectrum Health and Western Michigan University Institutional Review Boards. This research aligns with the principles of the Declaration of Helsinki and the ISHLT ethical statement.

2.3. Study design

The age, race, and sex variables were obtained from the "Demographics" section of the EMR. The psychosocial data was abstracted from social worker (SW) assessments. All patients evaluated for advanced therapies (heart transplant and LVAD) underwent a psychosocial assessment by a SW dedicated to the transplant department and experienced in screening AHF patients. The SW met with each patient, often multiple times, to determine psychosocial risk by assessing mental, emotional, and social characteristics relevant to the patient's potential heart failure treatment. The variables captured from the psychosocial notes included: marital status; caregiver/social support; substance use, mental health, cognitive and/or legal contraindications; and psychosocial risk. Each candidate must have adequate social support in place for the complex recovery process and potential caregivers were vetted by the SW. This includes one or more individuals who will be an active member of the patient's post-operative and long-term care. This caregiver, who is vetted by the SW, is expected to provide assistance with physical needs as well as support with emotional and compliance needs. Mental health was sometimes further assessed by a psychologist, and determinations from those notes were abstracted. While specific mental health diagnoses are not considered prohibitive to treatment, each patient is assessed on a case-by-case basis to assess for likelihood to treatment success. Substance use (tobacco, marijuana, or illicit drug use) noted by the SW as contraindication to treatment was abstracted. The psychosocial risk rating (low, moderate, or high) was collected from the EMR. This rating was assigned by the SW based on a summary of their assessment of each patient's psychological and social characteristics. Patients in the "low" category were determined to have a low risk of adverse outcomes after implantation or transplant, while increasing psychosocial characteristics resulted in a risk category assignment of moderate or high. Patients that were prohibitive risk and did not receive an LVAD or transplant were not included in the sample.

Insurance status (Medicaid only, Medicare only, both Medicare and Medicaid, private only, both public and private, or no insurance) was collected from the financial review and selection committee notes. Each patient was evaluated by a financial coordinator within the transplant department for appropriate insurance coverage before being approved for advanced therapies. The last step of the evaluation process was the multidisciplinary selection committee discussion of the psychosocial and financial assessments described above, along with appropriate clinical data. Approval decisions documented by the selection committee were abstracted from the EMR. Follow-up data, such as whether a patient ultimately received a transplant and/or LVAD, and patient mortality, was manually abstracted from the EMR. Data was entered and stored in a local REDCap database [25].

2.4. Statistical analysis

Independent variables included age, race, sex, marital status, caregiver/social support, mental health contraindications, cognitive contraindications, legal contraindications, substance use contraindications, and insurance status.

Comparisons included: 1) Patients who were evaluated and approved for heart transplantation and/or LVAD were compared to patients who were not approved; 2) Patients who were listed for transplant were compared to patients who were not listed; and 3) Patients who received the medically preferred treatment, whether heart transplant or LVAD, were compared to patients who did not receive advanced therapies (Fig. 1). Endpoints included approval for advanced therapy, listing for heart transplant, heart transplantation or LVAD implantation, and mortality.

Each outcome was evaluated by the demographic, psychosocial, and socioeconomic independent variables described above, using ANOVA for continuous variables and Chi-squared for categorical variables. To evaluate the contribution of predictor variables on the outcome and the

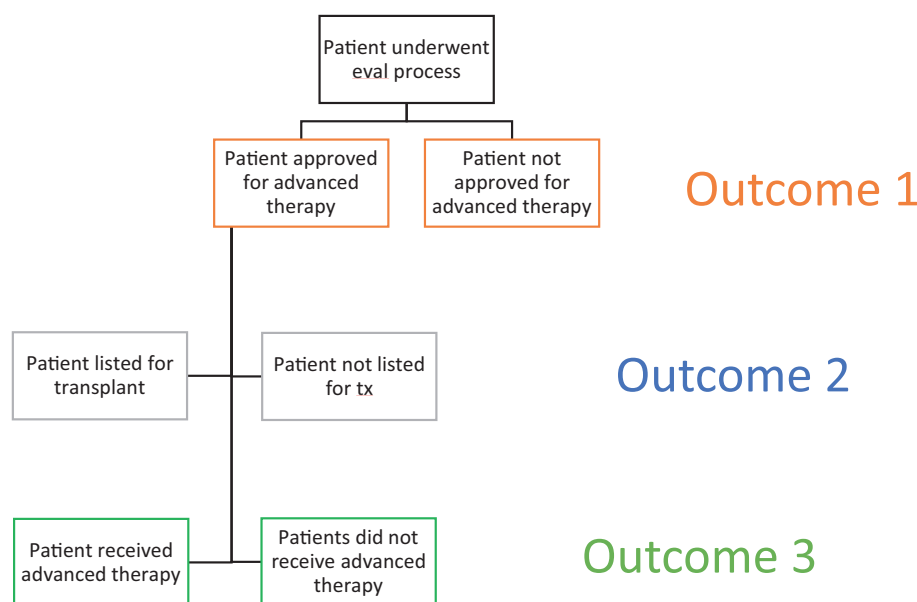


Fig. 1. Flowchart of three study outcomes. The first outcome was to determine differences between patients who were approved for advanced therapies versus those who were not. The second outcome compared patients who were listed for transplant versus those who were not. The third outcome compared patients who ultimately received advanced therapy versus those patients who did not.

strength of each predictor, the statistically significant variables from the above analyses were further evaluated by logistic regression. Values of $p \leq 0.05$ were considered statistically significant for all tests. All analyses were performed using SPSS [51].

3. Results

A total of 466 patients were identified as having an AHF evaluation. Of these patients, seven did not have documentation of their selection committee evaluation. Therefore, 459 patients were included in this analysis.

The baseline demographics for the patients evaluated for advanced therapies are shown in Table 1. Most of the population was married (59.0%), male (74.7%), and white (81.0%). Fourteen patients did not have substance use information available, thirteen patients did not have mental health documentation, and twelve patients did not have caretaker documentation. Only 370 patients (80.6%) had a psychosocial score recorded in the EMR. Ten patients had cognitive contraindications for transplant, but this resulted in too few counts for statistical analysis and the variable was therefore excluded. Similarly, too few patients were available for the uninsured category and presence of legal contraindication, making them insufficient for statistical significance and increasing the likelihood of confidentiality loss and were therefore excluded.

Table 2 shows the results from Outcome 1: The comparison between patients approved for advanced therapies and those not approved. Age ($p = 0.277$), sex ($p = 0.652$), and insurance status ($p = 0.052$) did not demonstrate significance as factors in whether patients were approved. Marital status ($p = 0.004$), race ($p = 0.008$), social support ($p < 0.001$), mental health contraindications ($p = 0.006$), substance use ($p < 0.001$), and psychosocial rating ($p < 0.001$) were all associated with selection for advanced therapies.

The 218 patients who received approval were assessed by comparing those listed for transplant versus those not listed (Table 3). Only psychosocial rating ($p = 0.006$) and insurance status ($p < 0.001$) were associated with whether selected patients were listed. Insurance status, which was not associated with whether patients were initially approved, was shown to be associated with listing.

The 218 patients approved for advanced therapies were also assessed

by comparing patients who were approved and received advanced therapy versus the patients who were approved and did not receive advanced therapy (Table 4). There was no difference in demographics, psychosocial variables, or insurance status between patients who received the treatment they were approved for and those who did not (Table 4).

The predictor variables that were significant in the above Chi-square analyses were assessed by logistic regression (Table 5). For the comparison between patients approved for advanced therapy and those not approved, patients with social support were over three times as likely to be approved compared to patients without social support. Patients with substance use contraindications were about half as likely to be approved. Patients with fewer psychosocial concerns were 3.6 times more likely to be approved compared to patients with moderate scores. Marital status, race, and mental health were not significant in the regression analysis. The logistic regression analysis comparing patients listed for transplant versus those not listed revealed that patients with fewer psychosocial concerns were 2.8 times more likely to be listed compared to patients assigned moderate scores (Table 6). Publicly insured patients were half as likely to be listed for transplant compared to the privately insured.

4. Discussion

This single center, retrospective analysis demonstrated that publicly insured patients were half as likely to be listed for a transplant. Inferior outcomes of the publicly insured after heart transplantation have been noted in the literature [26]. In a single center study, Hutcheson et al. found that among patients ineligible for transplant or LVAD, those with Medicaid insurance had higher risk of one-year mortality [13]. Previous research demonstrated public insurance as well as transitioning from private to public insurance were associated with increased mortality one year after heart transplantation [27]. Additional research has shown lower survival in patients with Medicaid or Medicare insurance compared to the privately insured [28,29]. Allen et al. suspected that ease of access to follow-up care and coverage of immunosuppressive medications may be contributing factors to mortality [28]. Therefore, access problems for patients with Medicaid or Medicare insurance may directly influence post-transplant outcomes. It is also possible that

Table 1
Baseline demographics of patients evaluated for advanced heart failure treatment.

Variable	Category	N (%)
Marital status	Unmarried	188 (41.0)
	Married	271 (59.0)
Sex	Female	116 (25.3)
	Male	343 (74.7)
Race	Black/African American	52 (11.3)
	White	372 (81.0)
	American Indian/Alaska Native; Asian; Native Hawaiian/other Pacific Islander; or Hispanic	20 (4.4)
	Unknown/not reported	15 (3.3)
Social support/ caretaker in place	Yes	397 (86.5)
	No	50 (10.9)
Mental health contraindication	Null	12 (2.6)
	Yes	15 (3.3)
Substance use	No	431 (93.9)
	Yes	13 (2.8)
Psychosocial rating	Null	101 (22.0)
	Low	344 (74.9)
	Moderate	14 (3.1)
	High	136 (29.6)
Insurance status	Null	125 (27.2)
	Medicaid only	109 (23.8)
	Medicare only	89 (19.4)
	Private only	26 (5.7)
	Both public and private	43 (9.4)
	Both Medicaid and Medicare	162 (35.3)
	Null	201 (43.8)
	Both Medicaid and Medicare	25 (5.4)
	Null	2 (0.4)

publicly insured patients may be evaluated for AHF when they are in a more advanced disease state, affecting their likelihood of successful outcomes with transplant or LVAD placement. Public insurance coverage has increased in recent years among heart transplant recipients, with Medicare showing the largest increase [30]. While Medicare allows more patients access to healthcare, it may not provide as much coverage as private insurance. Even though Medicare part B covers immunosuppressive medications, transplant patients commonly need anti-infective and other high-cost medications for which Medicare requires a 20 % copayment [26] and depending on the insurance plan, patients may only have partial coverage. Because of this, multiple Medicare coverage plans are required for transplantation at many centers [30,31]. Our findings suggest a bias against publicly insured patients. This is likely driven by the data that has observed worse outcomes in publicly insured patients.

The current study also demonstrated that patients with a caregiver were over three times as likely to be approved for advanced therapies. In a prospective study of heart, lung, or liver recipients, less social support, especially medication-related support, was associated with medication nonadherence one-year post-transplant [32]. The goal of the evaluation is to choose candidates who will have success post-transplant or post-LVAD, but caregiver needs may differ from patient to patient. Certain

demographics may struggle with caregiver requirements more than others, inducing bias into the selection process. Bui et al. has suggested that psychosocial evaluations be individualized based on differences in estimated caregiver needs [33]. However, without clear definitions of social support requirements, variability between programs will exist and contribute to disparities in the selection process.

In addition to the social support variable, the current study found that married patients were more likely than unmarried patients to be approved. Previous research has demonstrated that patients with spouses had improved 1-year and 5-year survival after heart transplantation, but children or grandchildren did not show the same improvements [34]. Spousal care and support may therefore improve the overall health of transplant recipients. Similar findings have been described in lung transplantation, with spousal caregivers being associated with improved survival in lung recipients rather than siblings or children as caregivers [35]. Even though married recipients exhibited better post-transplant outcomes in the literature, our data raises a concern for selection of married patients. Transplant care teams often encourage the potential candidate to find social support. This can be a challenging process, especially for unmarried candidates, and for those not accustomed to asking for help. Many patients struggle and are unable to recognize a potential community of support. The amount of coaching each patient receives from the care team may vary, introducing a potential point of bias, and this warrants additional research.

Patients with substance use had half the odds of being approved. This result is expected as tobacco and alcohol use is generally a contraindication to heart transplant and recommended against for LVAD eligibility [17]. Previous research demonstrated that LVAD recipients who were smokers at the time of admission for implant had a high risk of one-year mortality [36]. More research is needed to understand if substance use is indicative of worse outcomes post-transplant and post-LVAD and what treatments may assist in reducing the risk of poor outcomes.

Two variables, race and mental health, were associated with approval in the Chi-squared analysis but not in the logistic regression. While these variables showed individual contribution in the Chi-squared test (Table 2), their contribution in the regression model was less than the other variables present in the model (Table 5). The findings agree with previous research which established the effect race has on access to cardiovascular services [41,42], but further research is needed to understand the intersectionality of race with other social and economic factors affecting candidacy. Despite issues with access, previous research has shown similar mortality between African Americans and Caucasians with heart failure and after heart transplantation even though African Americans had greater severity of illness [43]. It appears that race may be a marker of other social or demographic factors (social determinants of health) that ultimately influence advanced therapy candidacy. This may indicate opportunities for upstream interventions to address social determinants of health with the overall goal of improving equity in access.

With regard to mental health, contraindications to advanced therapy candidacy should be met with potential interventions, but not all patients will succeed and become eligible and some may have such advanced disease states as to not have the time needed to be successful with mental health treatment. Future research on the intersection between social support and mental health is needed, since patients with mental health concerns may be approved for candidacy due to exceptional support.

Unlike advanced therapy recipients, patients who are ineligible are not maintained in registries [13,15]. Therefore, manual abstraction of the EMR at a transplant hospital, as was done here, is the primary way to capture this population. The retrospective nature of this research is a limitation, although despite the observational nature, this study agrees with previous research demonstrating socioeconomic, racial, or gender discrepancies in the allocation of AHF services [13,41,42] or cardiovascular referral [52].

While previous studies have demonstrated limitations in access to

Table 2

Comparison of patients who were approved for advanced therapy versus those who were not approved.

Variable	Category	Approved for advanced therapy Mean ± SD or N(%)	Not approved for advanced therapy Mean ± SD or N(%)	p value
Age		55.7 ± 13.014	56.66 ± 11.235	0.277
Sex				0.652
	Female	53 (45.7)	63 (54.3)	
	Male	165 (48.1)	178 (51.9)	
Marital status				0.004
	Unmarried	74 (39.4)	114 (60.6)	
	Married	144 (53.1)	127 (46.9)	
Race				0.008
	Black/African American	15 (28.8)	37 (71.2)	
	White	189 (50.8)	183 (49.2)	
	American Indian/Asian/Native Hawaiian/other Pacific Islander/Hispanic/unknown/not reported	14 (40.0)	21 (60.0)	
Social support/caretaker in place				<0.001
	Yes	210 (52.9)	187 (47.1)	
	No	6 (12.0)	44 (88.0)	
Mental Health Contraindication				0.006
	Yes	2 (13.3)	13 (86.7)	
	No	214 (49.7)	217 (50.3)	
Substance use				<0.001
	Yes	28 (27.7)	73 (72.3)	
	No	188 (54.7)	156 (45.3)	
Psychosocial rating				<0.001
	Low	96 (70.6)	40 (29.4)	
	Moderate	61 (48.8)	64 (51.2)	
	High	28 (25.7)	81 (74.3)	
Insurance status				0.052
	Medicaid only	9 (34.6)	17 (65.4 %)	
	Medicare only	13 (30.2)	30 (69.8)	
	Private only	87 (53.7)	75 (46.3)	
	Both public and private	95 (47.3)	106 (52.7)	
	Both Medicaid and Medicare	12 (48.0)	13 (52.0)	

ANOVA for continuous variables and Chi square for categorical variables.

heart failure services, this research was the first to assess the granular information in psychosocial notes, financial notes, and selection committee notes in the EMR and how patient characteristics affect the selection process for transplant or LVAD. Large national databases lack psychosocial data [34] and do not record patients determined ineligible for advanced therapies, which was the focus of the current study. This research investigated a large cohort of AHF patients evaluated for advanced therapies from one transplant program. Future research should incorporate multicenter data.

Limitations of the study included the large proportion of males and white patients in this sample. Insurance status and psychosocial characteristics were noted at time of evaluation, so any changes after evaluation were not accounted for. The study did not have enough participants to assess cognitive ability or legal contraindications. Additionally, this study did not differentiate between destination therapy (DT) and bridge-to-transplant (BTT) LVAD evaluations. Institutions may set different criteria for DT and BTT eligibility, but this study aimed to assess overall selection for advanced therapies, regardless of implantation strategy. Regardless of strategy, the evaluation is used to determine selection criteria in addition for post-treatment care for supporting optimal outcomes [17]. An additional limitation was that changes in status were not captured after the patient's evaluation. For example, 12 patients who were listed for transplant were noted to have substance use as a contraindication in their SW evaluation notes. These patients likely abstained from substance use before being listed for transplant, and a higher level of granularity is needed in order to determine the course of events for each individual patient. Further, only demographic, social, and economic data was included in this study. Clinical data was not included in order to focus on the non-clinical factors influencing selection. Further, the reasons why patients may have been accepted and do not receive treatment may extend beyond the scope of this retrospective

review. Clinical factors may result in patients becoming ineligible for treatment after selection, or patients may decline advanced therapies. Future research should include clinical variables in regression models.

It is interesting to note that the population included in our analysis, patients who reached the point of evaluation for advanced therapies, was predominantly white, male, and married. Future prospective research is needed to better understand if a referral bias exists and how patients may be excluded from eligibility before they even undergo the evaluation process. Women and men both have a 20 % chance of developing heart failure in their lifetime [47], but women only accounted for 25 % of persons evaluated for advanced therapies. Women are often older and have more comorbidities when they are diagnosed and treated for their heart disease which may have some impact [46,47]. Nonetheless, the current distribution in who is selected for advanced therapies suggests that more research is needed to look at upstream factors including social determinants to improve equity in the use of advanced therapies.

Some strategies may improve equity in the distribution of advanced therapies. This could include increased availability of health coaching to help improve psychosocial risk profiles before candidacy. At-risk patients or populations could be identified who might need more coaching than others, and this should be done to improve equity in allocation. Increased patient advocacy is also needed, as patients believe their socioeconomic status affects access and the quality of care received [44] and is important in influencing healthcare policy [31]. While the psychosocial assessment at our institution is of great import, as indicated by the significance in the psychosocial score variable, additional factors should be investigated when researching advanced therapy assessments, such as transportation, health literacy, access to primary care, reliance on secondary care, and clinician perception [48,49]. Transplant programs should work with their healthcare system to navigate funding

Table 3
Comparison of patients who were listed for transplant versus those who were not listed.

Variable	Category	Listed for transplant Mean ± SD or N(%)	Not listed for transplant Mean ± SD or N(%)	p value
Age		54.70 ± 13.04	57.33 ± 12.89	0.164
Sex				0.092
	Female	38 (71.7)	15 (28.3)	
	Males	97 (58.8)	68 (41.2)	
Marital status				0.219
	Unmarried	50 (67.6)	24 (32.4)	
	Married	85 (59.0)	59 (41.0)	
Race				0.770
	Black/African American	8 (53.3)	7 (46.7)	
	White	118 (62.4)	71 (37.6)	
	American Indian/Asian/ Native Hawaiian/other Pacific Islander/ Hispanic/unknown/not reported	9 (64.3)	5 (35.7)	
Substance use				0.021
	Yes	12 (42.9)	16 (57.1)	
	No	123 (65.4)	65 (34.6)	
Psychosocial rating				0.006
	Low	70 (79.2)	26 (21.7)	
	Moderate	34 (55.7)	27 (44.3)	
	High	12 (42.9)	16 (57.1)	
Insurance status				0.001
	Private only	65 (40.1)	97(59.9)	
	Public/Public+Private	74 (25.1)	221 (74.9)	

ANOVA for continuous variables and Chi square for categorical variables.

Table 4
Comparison of patients who were approved and received a heart transplant or LVAD versus those who were not approved.

Variable	Category	Received LVAD and/or transplant as first choice Mean ± SD or N (%)	Did not receive LVAD or transplant as first choice Mean ± SD or N (%)	p value
Age		55.90 ± 12.646	54.69 ± 14.892	0.741
Sex				0.916
	Female	44 (83.0)	9 (17.0)	
	Male	138 (83.6)	27 (16.4)	
Marital status				0.392
	Unmarried	64 (86.5)	10 (13.5)	
	Married	118 (81.9)	26 (18.1)	
Psychosocial rating				0.524
	Low	85 (88.5)	11 (11.5)	
	Moderate/High	76 (85.4)	13 (14.5)	
Insurance status				0.852
	Private only	72 (82.8)	15 (17.2)	
	Public/ Public+Private	108 (83.7)	36 (16.7)	

ANOVA for continuous variables and Chi square for categorical variables.

challenges and improve access to socially disadvantaged populations.

In summary, the goal of heart transplantation and LVAD implantation is to improve survival and quality of life for patients with AHF, although an equitable allocation system is needed. Patients with a caregiver and without substance use concerns were more likely to be approved for advanced therapies, and patients with public insurance were half as likely to be listed for transplant. It is essential to select

Table 5
Logistic regression analysis of significant variables from Outcome 1: Comparison of patients approved for advanced therapy versus those who were not approved.

	B	S.E.	Wald	df	Sig	Exp (B)
Marital status	0.96	0.247	0.150	1	0.699	1.100
Social support/caretaker in place	1.218	0.496	6.038	1	0.014	3.381
Mental health contraindications	-0.692	0.849	0.665	1	0.415	0.500
Substance use	-0.703	0.304	5.357	1	0.021	0.495
Race (White)	0.631	0.471	1.799	1	0.180	1.880
Race (Black)	-0.001	0.595	0.000	1	0.998	0.999
Psychosocial score (low)	1.287	0.337	14.558	1	0.000	3.622
Psychosocial score (moderate)	0.523	0.319	2.694	1	0.101	1.687
Constant	-2.279	0.738	9.528	1	0.002	0.102

Variables entered in regression: Marital Status, Social support/caretaker in place, Mental Health Contraindications, Substance Use, Race, Psychosocial Score.

Table 6
Logistic regression analysis of significant variables from Outcome 2: Comparing patients who were listed for transplant versus those who were not listed.

	B	S.E.	Wald	df	Sig	Exp (B)
Substance use	-0.333	0.494	0.454	1	0.500	0.717
Psychosocial score (low)	1.044	0.488	4.584	1	0.032	2.841
Psychosocial score (moderate)	0.376	0.493	0.582	1	0.445	1.457
Insurance (public)	-0.719	0.342	4.414	1	0.036	0.487
Constant	0.413	0.500	0.683	1	0.408	1.511

Variables entered in regression: Substance Use, Psychosocial Score, and Insurance.

patients who will benefit the most from either treatment, however, equity in distribution is likewise important. Successful heart transplant and LVAD outcomes requires multidisciplinary decision-making as well as patient advocacy. Upstream interventions that reduce barriers, such as resources for caregiver support and health insurance coverage, are necessary for improvement in equity of advanced therapy allocation.

CRedit authorship contribution statement

Catherine Kelty was involved in study conception, collection and analysis of all data used in this research, interpretation of results, and was the primary manuscript writer. As Catherine's doctoral adviser, Dr. Kieran Fogarty provided technical guidance and advising throughout the data collection and analysis process, assisted with interpretation of data, and contributed to critically revising the manuscript for intellectual content. Dr. Michael Dickinson provided advising and medical expertise in the area of AHF and organ allocation and contributed to the study design, interpretation of data, and critical revision of the final manuscript.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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