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The Effect of Existing Heart Allocation Criteria on Transplant Outcomes Globally: A Systematic Review

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Abstract

Introduction: Adult and pediatric heart allocation systems worldwide categorize transplant patients based on diverse criteria that impact mortality rates and quality of life. However, there is limited research examining the effectiveness of these systems. This study aims to address this gap by comprehensively comparing different adult heart allocation systems and a pediatric allocation system to identify potential challenges and provide valuable insights for optimizing heart transplant allocation strategies.
Methods: The review was conducted in accordance with the Cochrane Handbook for Systematic Reviews of Interventions. The protocol was registered in PROSPERO (CRD42024513009). An Ovid-MEDLINE and Ovid-Healthstar database search was conducted from January 1, 2024 to January 21, 2024 with relevant search terms. Articles were selected if they used quantitative or qualitative data, were published in the English language, described defined allocation frameworks specific to cardiac surgeries, data was retrieved from hospital-based interventions, and were peer-reviewed. Reviewers screened all articles using the COVIDENCE tool with vetted articles undergoing full-text extraction. The JBI Critical Appraisal tool for systematic reviews was used for risk of bias assessment. A thematic analysis was conducted with a qualitative analysis of intervention effectiveness. The *robvis* tool assessed the risk of reporting bias.
Results: The database search yielded 630 unique articles. Following screening, 15 articles were selected for analysis. The selected articles described four countries' national allocation policies; the United Kingdom (n=1), Switzerland (n=1) France (n=2), and the United States of America (n=11). The articles, published between 2016 and 2024, focused on comparing patient outcomes and waitlist times before and after national allocation policy changes.
Discussion: Five articles found improvement in patient outcomes, six articles reported improvement in patient mortality, and six articles found a reduction in waiting time following policy change. The review identifies mixed results regarding the efficacy of various heart allocation frameworks.
Conclusion: The study emphasizes a requirement for further research due to limited access to relevant articles. Additionally, global heart allocation networks are urged to report patient outcomes to allow for a broader, comprehensive analysis of framework efficacy, thereby allowing for a successful informing of policies.

Keywords: heart allocation system; OPTN; heart transplantation; patient prioritization

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Introduction

Despite successful medical interventions for end-stage cardiovascular disease, heart transplants remain a crucial option for patients seeking both survival and an improved quality of life. The growing demand for organs within this population presents a set of challenges that have gained prominence, including the pressing need for donors, ensuring equitable access, and implementing optimal risk stratification [1].

The United Network for Organ Sharing (UNOS) operates as the Organ Procurement and Transplantation Network (OPTN) through a contract with the Department of Health and Human Services [2]. National OPTN data as of February 2024 highlight the heart's status as the third most in-demand organ, behind the kidney and liver, with a waitlist of 3,368 candidates [3]. However, despite the substantial number of candidates awaiting heart transplants, there has been a positive trend in reducing mortality rates among patients on the transplant waitlist over the years [3].

Collaborative efforts between OPTN and the Scientific Registry of Transplant Recipients reveal a consistent mortality rate among transplant candidates from 2010 to 2015. However, from 2019 to 2021, there was a 39.4%

decline in mortality rates, demonstrating progress and stabilization in patient outcomes [3].

Beyond mere survival, quality of life becomes a concern for patients enduring prolonged wait times on the transplant list. A previous study has shown that heart transplant candidates not only face physical challenges but also psychological and cognitive difficulties [4]. These include impaired verbal memory performance, elevated depression, and abnormal anxiety levels [4, 5].

The onset of the COVID-19 pandemic in 2020 also impacted the number of candidates listed for transplantation. Pediatric waitlist mortality decreased from 5.31% to 4.73%, with a 28-day reduction in mean waitlist time, while adult waitlist mortality also decreased more significantly, from 18.44% to 15.70%, with a 40-day reduction in waitlist time [6]. This was potentially due to several health centers in the United States deactivating some patients on the transplant list [6]. The goal was to prioritize those at most risk of contracting COVID-19, as further illness may have led to the progression of their heart condition [6]. The reduction in waitlist mortality was also associated with a decrease in waitlist additions due to delays in physician consultations [6]. The improved outcomes and efficiency were not attributed to current waitlist management strategies, but because of the aforementioned circumstances.

Emphasizing the challenges associated with heart transplantation surgeries underscores the importance of effective waitlist management. This is not only in terms of reducing mortality rates but also in enhancing overall well-being of patients. In 2018, the OPTN/UNOS board transitioned from a 3-tiered to a 6-tiered heart allocation system [7]. The previous system, implemented in 2006, had seen modifications over the past decade to increase the chances of survival for individuals on the waiting list while maintaining or improving success rates and the quality of life for transplant recipients [2]. Despite these improvements, certain groups continued to experience high waitlist mortality, highlighting the need for a more thorough evaluation of candidates and equitable access for those with the most clinical urgency [2].

The decision to reassess the system was further prompted by various factors, including 1) an increase in transplant candidates without a comparable increase in donors; 2) a surplus of candidates with multifaceted levels of urgency within a single urgency status (Status 1A); and 3) the increased usage of ventricular assist devices [2, 8].

A recent cohort study compares the impact of the 2006 and 2018 systems. The analysis indicates that waitlist outcomes have improved post-policy implementation, as there are higher rates of transplantation and lower rates of waitlist mortality [9]. Furthermore, the broad designation of patients to the most urgent status, Status 1A, has been optimized by increasing the number of tiers available to separate patients [9].

However, despite these changes, the study noted a 4.6% reduction in post-transplant survival since the policy change [9]. This decline has been attributed to the changes in recipient characteristics, shifting towards factors that are known to be risks for post-transplant mortality [9]. This change in the patient population indicates the need to evaluate and reconstruct more suitable allocation systems. It is also important to highlight that the current heart transplant allocation policy primarily focuses on reducing waitlist mortality, but the responsibility for post-transplant mortality typically falls under individual transplant centers [9].

In tandem, systems like the OPTN's kidney allocation system (KAS) have demonstrated success in enhancing equity and longevity matching, but challenges like proper organ utilization require further examination to improve efficiency [10]. Regardless, both kidney and heart allocation strategies serve to improve patient outcomes and quality of life. Applying successful strategies from KAS to the heart allocation system could enhance overall effectiveness. For instance, KAS accounts for ethnic minorities as a prioritization measure [10, 11]. On the other hand, a study conducted among approximately 32,000 patients found that there are significant disparities in the number of black patients listed for transplantation, where they were less likely to be transplanted and had a higher risk of post-transplantation mortality compared to their white counterparts [12].

An additional example pertains to patient recruitment on the transplantation list. In the case of kidneys, the waiting period is initiated based on documented medical needs and the beginning of chronic dialysis [10]. This approach aims to mitigate potential disadvantages for patients who, due to factors such as limited access to information about treatment options or delayed referrals, undergo years of dialysis before listing [10]. Conversely, individuals awaiting a heart transplant must first secure a referral from their physician, contact a transplant hospital, and be evaluated before they can be added to the list [13]. While patients in need of kidney transplants still need to be referred and evaluated, the waitlist time is still marked by the start of dialysis which may reduce overall waiting time.

Currently, there is a lack of comprehensive reviews examining the outcomes of both the UNOS 2018 heart allocation system and other global heart allocation systems. For this reason, a systematic review methodology was selected to summarize the findings of existing literature to quantify patient mortality rates. These findings can be used to better evaluate existing schemes and to aid in the construction of future heart allocation systems.

Methods

This review was conducted in accordance with the Cochrane Handbook for Systematic Reviews of Interventions, reported in accordance with the Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) 2020 guidelines. The review protocol was registered through PROSPERO (CRD42024513009).

Eligibility Criteria

The inclusion eligibility criteria used in the selection process is as follows: (1) Articles were qualitative (i.e., case studies, demographics) and used quantitative (i.e., random selection, controls) methods to examine the use of allocation frameworks; (2) Articles were published in the English language; (3) Articles described the use of allocation frameworks specific to managing waitlists for cardiac surgeries; (4) Articles used data from hospital-based interventions; (5) Articles were peer-reviewed. The exclusion criteria used is as follows: (1) Articles described the use of allocation frameworks for non-surgical cardiac interventions; (2) Articles used waitlist management strategies rather than a defined prioritization system; (3) Articles were secondary research articles (literature review, opinion articles, narrative studies, etc.)

Information Sources

The Ovid-MEDLINE and Ovid-Healthstar databases were used to identify English-language articles published from January 1, 2014, to January 21, 2024, the date the search was conducted.

Search Strategy

A comprehensive literature analysis was conducted using the Ovid-MEDLINE and Ovid-Healthstar databases to identify relevant English-language articles published as of 2014. The following search terms with corresponding syntax were used to align with the MEDLINE and Healthstar databases: exp Heart/, exp Cardiac Surgical Procedures/, exp Cardiovascular Abnormalities/ or exp Cardiovascular Diseases/, 1 or 2 or 3, exp Transplants/, 4 and 5, exp Heart Transplantation/, 6 or 7, exp Waiting Lists/, ((Wait* or List* or Queue or Short*) adj2 (Manag* or Tool* or Priorit* or Strategy)).tw,kf., 9 or 10, 8 and 11, limit 12 to (english language and humans and yr="2014 -Current").

Selection Process

After conducting the search within the databases, the retrieved studies were screened by two independent reviewers in duplicate using a predetermined criterion. The title and abstracts of the articles were screened primarily through the COVIDENCE tool, which compiles articles and eliminates duplicates. Resulting conflicts were resolved by a third, independent reviewer who cast the final inclusion or exclusion vote. Following, two independent reviewers conducted a full-text screen in duplicate with conflicts resolved by a third, independent reviewer.

Data Collection Process

Subsequently after the full-text review, two authors collected the following qualitative data independently from the selected articles: article title, year of publication, the first author's name, journal name, the sample size and hospital involved, the specific group of focus, a brief description, the author's considerations when ranking patients, mortality and survival outcomes, quality of life, and wait times recorded.

Study Risk of Bias Assessment

To minimize collection bias, a third reviewer and extractor was used in periods of conflict during the title and abstract screening, in addition to the full-text extraction. Risk of bias was assessed using the Joanna Briggs Institute (JBI) Critical Appraisal tool for systematic reviews. Refer to the supplementary materials for further information.

Synthesis Methods

The collected data was assessed, and a thematic analysis was conducted. Additionally, the effectiveness of interventions was compared, and a qualitative analysis was performed.

Reporting Bias Assessment

The tool, *robvis*, was used to assess the risk of bias for each assessed synthesis. Refer to the supplementary materials for further materials.

Results

Study Selection

Figure 1 describes the process of study selection. The initial search of Ovid-MEDLINE and Ovid-Healthstar databases retrieved 1271 articles of which 641 were duplicates. The remaining 630 articles underwent title and abstract screening. 599 articles did not meet the inclusion criteria and were excluded from further screening. Primary reasons for exclusion at this stage were incorrect article type (review, commentary, opinion, etc.), inadequate intervention (lack of allocation system) or out-of-scope (multi-organ transplants, mechanical assist devices). The 31 articles eligible for full-text screening were assessed and 15 were selected for data extraction. The reasons for exclusion at this stage were secondary analysis of waitlist effectiveness (n=4), review articles (n=2), no intervention (n=4), no relevant comparator (n=4) and no relevant patient outcomes (n=2). A total of 15 articles were analyzed for this systematic review.

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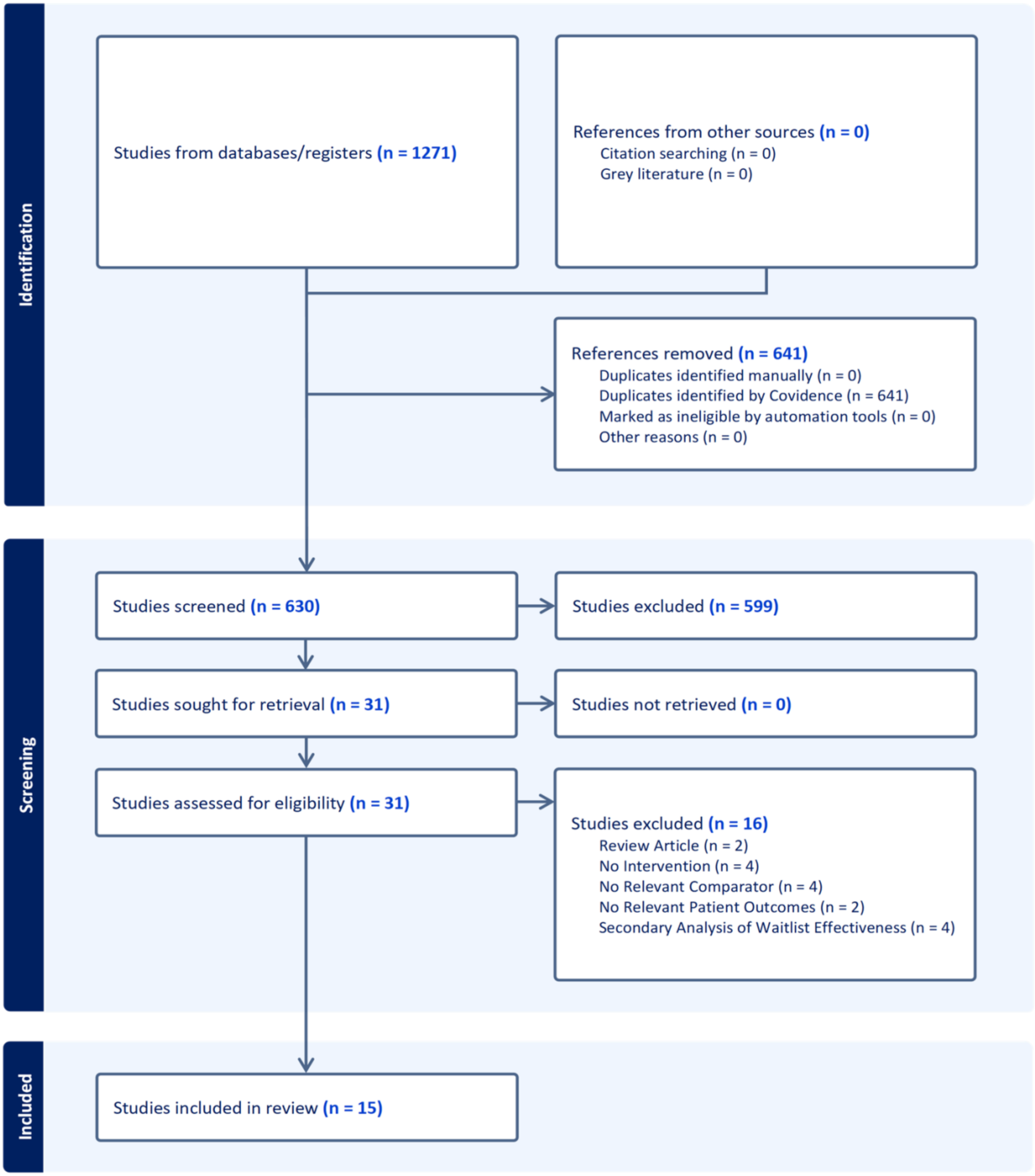


Figure 1. PRISMA Flow Diagram Generated by Covidence.

Characteristics of Included Studies

The 13 adult and 2 pediatric articles that were included were published from 2019 to 2024. Details of the selected articles can be found in Table 1 and 2 respectively.

Table 1. Extraction Table Summarizing Outcomes for Adult Transplants Based on Heart Allocation System Used

Study	Author	Year	Sample Size	Disease	Country	Outcome
1	Catherine Kelty	2024	26.450	All	United States	N/I
2	Ajay Vaidya	2023	3228	All	United States	Improved
3	Eva Desire	2023	855	All	France	Mixed
4	Keighly Bradbrook	2023	15,624	All	United States	Mixed
5	Lucie Daniel	2023	364	All	France	N/R
6	Jay N. Patel	2021	17,422	All	United States	Mixed
7	Katia Bravo-James	2021	535	Congenital Heart Disease	United States	Improved
8	Arman Kilic	2021	15,631	All	United States	Improved
9	Atsushi Kainuma	2021	1206	Congenital Heart Disease	United States	N/I
10	Sally Rushton	2020	978	All	United Kingdom	Improved
11	Milena Jani	2020	399	Congenital Heart Disease	United States	Improved
12	Rebecca Goff	2019	13,208	All	United States	Mixed
13	Julius Weiss	2014	300	All	Switzerland	N/I

"N/I" represents an outcome that was "not improved", "N/R" represents an outcome that was "not reported" by the study, and "Mixed represents outcomes that indicated improvement with some conditions but not others

Table 2: Extraction Table Summarizing Outcomes for Pediatric Transplants Based on Heart Allocation System Used

Study	Author	Year	Sample Size	Disease	Country	Outcome
14	Ryan J. Williams	2021	1789	Congenital Heart Disease, Dilated Cardiomyopathy, Restrictive Cardiomyopathy, Hypertrophic Cardiomyopathy, Graft Failure	United States	N/I
15	Defne Magnetta	2019	5261	Cardiomyopathy, Congenital Heart Disease	United States	Improved

"N/I" represents an outcome that was "not improved"

Geographical Location

Studies were based on allocation systems from four countries; the United Kingdom (n=1), Switzerland (n=1), France (n=2) and the United States of America (n=11). Each study investigated the respective national allocation policy. The American studies had nine articles based on the 2018 UNOS Allocation Criteria and two articles which discussed pediatric populations based on the 2016 UNOS pediatric allocation policy.

Design of Study

The majority (n=13) of included studies involved a comparison of the waitlist and patient outcomes before and after a policy change. All studies were retrospective, looking at data from a time frame of less than one year to up to five years. Most studies (n=13) used national databases while two articles were based on patients from a single hospital.

Patient Population/Disease Condition

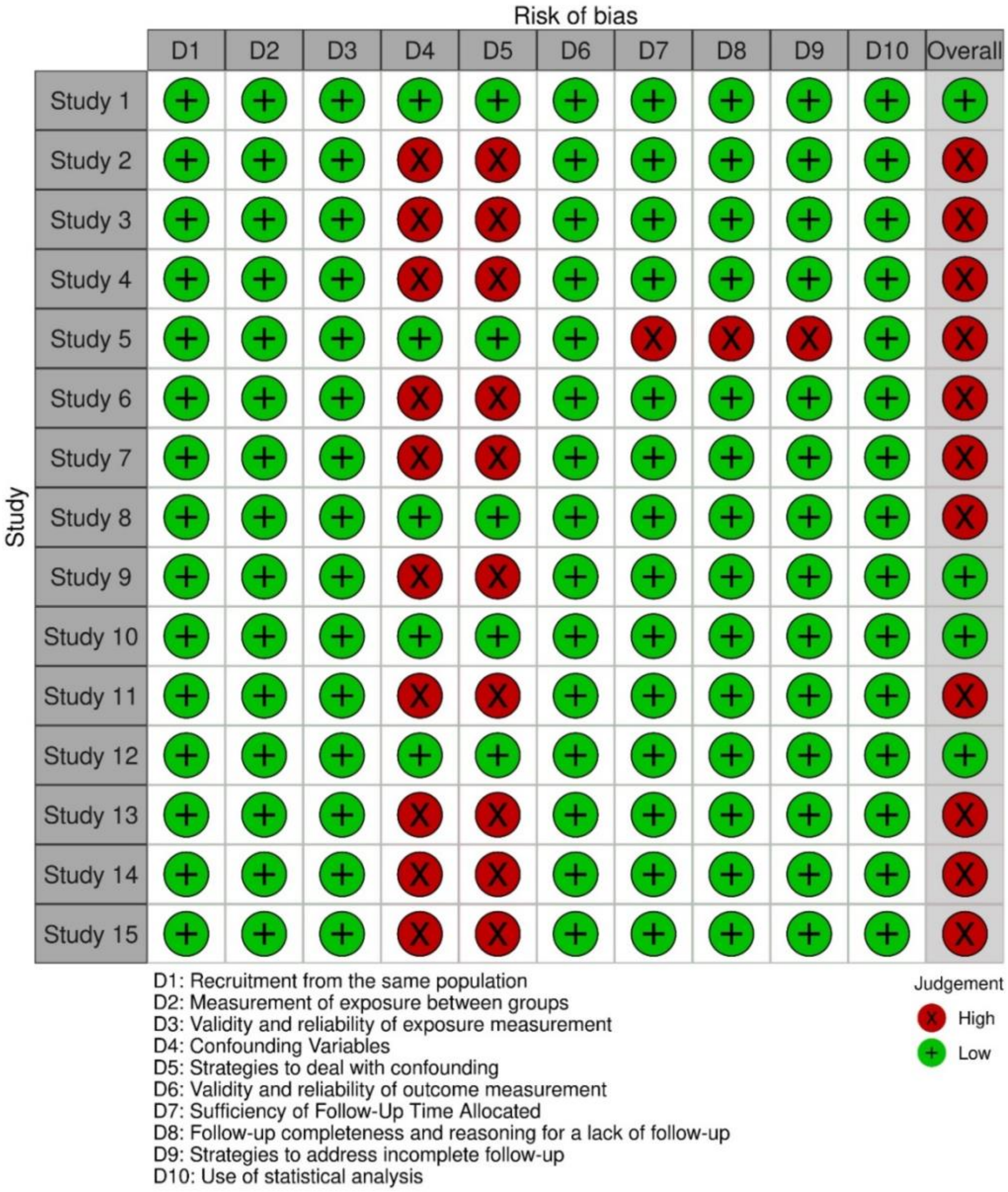
The selected studies covered a total population of 115,438 patients. Few studies (n=5) had a total sample size of less than 1000 with participants ranging from 300-978. The remaining studies (n=10) had total sample sizes ranging from 1206-26,450 with the upper end being a unique case that focused on socioeconomic status. Studies examined disease states including congenital heart disease (heart abnormalities present at birth), cardiomyopathy (disease of the heart muscle), coronary artery disease (restricted blood supply to the heart), and graft failure (when a heart transplant is unsuccessful). Seven articles examined all possible disease states, and six articles did not consider disease type.

Patient Outcomes

Assessing overall patient outcomes post-transplantation, five articles found no improvement, five found statistically significant improvement, four reported mixed results and one did not report outcomes. Improvements were found with both the UNOS Policy (n=4) and the UK Heart Allocation Policy (n=1). Six articles reported a statistically significant improvement in patient mortality, five reported no improvement, three reported mixed results and one article did not report comparative statistics. The improvement in patient mortality was seen across all allocation systems except the UK Heart Allocation Policy which had mixed results. Six articles discussing the UNOS Pediatric (n=1), UNOS Adult (n=4) and UK Health (n=1) Allocation Policies reported a reduction in wait time following the implementation of the respective allocation system. No reduction in waiting time information was reported for the Swiss and French Organ Allocation System.

Risk of Bias Assessment

Using the JBI Critical Appraisal Tool, most studies (n = 11) were found to lack discussion on potential confounders and strategies that could have been used to overcome them. One study reported potential confounders but did not report the length of follow-up times for patients under observation. The results are shown in Figure 2.



Study	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	Overall
Study 1	+	+	+	+	+	+	+	+	+	+	+
Study 2	+	+	+	X	X	+	+	+	+	+	X
Study 3	+	+	+	X	X	+	+	+	+	+	X
Study 4	+	+	+	X	X	+	+	+	+	+	X
Study 5	+	+	+	+	+	+	X	X	X	+	X
Study 6	+	+	+	X	X	+	+	+	+	+	X
Study 7	+	+	+	X	X	+	+	+	+	+	X
Study 8	+	+	+	+	+	+	+	+	+	+	X
Study 9	+	+	+	X	X	+	+	+	+	+	+
Study 10	+	+	+	+	+	+	+	+	+	+	+
Study 11	+	+	+	X	X	+	+	+	+	+	X
Study 12	+	+	+	+	+	+	+	+	+	+	+
Study 13	+	+	+	X	X	+	+	+	+	+	X
Study 14	+	+	+	X	X	+	+	+	+	+	X
Study 15	+	+	+	X	X	+	+	+	+	+	X

D1: Recruitment from the same population
D2: Measurement of exposure between groups
D3: Validity and reliability of exposure measurement
D4: Confounding Variables
D5: Strategies to deal with confounding
D6: Validity and reliability of outcome measurement
D7: Sufficiency of Follow-Up Time Allocated
D8: Follow-up completeness and reasoning for a lack of follow-up
D9: Strategies to address incomplete follow-up
D10: Use of statistical analysis

Figure 2. Critical Appraisal of the Included Studies. Studies 1 through 13 (adults) and 14 through 15 (pediatrics) were evaluated using the JBI Critical Appraisal Tool for Systematic Reviews. A summary of the appraisal was visualized using the Risk of Bias Visualization Tool (*robvis*).

Discussion

Heart allocation systems are critical in maintaining donation equity amidst the need for increased heart donors. The UNOS Adult and Pediatric heart allocation framework, French heart allocation scheme, UK heart allocation policy, and Swiss Organ Allocation System (SOAS) aim to identify patients requiring the most urgent care, ensuring that if matched, they are the primary transplant recipients. This systematic review, supported by results, elucidates varying framework efficacies on waitlist outcomes.

2018 UNOS Heart Allocation System

In 2018, UNOS introduced a modified heart allocation framework aimed at improving waitlist times and patient outcomes. Specifically, the policy aimed at addressing the increasing number of sick patients on the transplant waitlist, the need for accurate prioritization of patient sickness, and the impact of mechanical circulatory support (MCS) devices, specifically those with left ventricular assist devices. The previously used 3-tiered system (status 1A, 1B, and 2) was substituted for a 6-tiered system, dividing status 1A into 3 categories (status 1, 2, and 3), creating status 4 to correspond with status 1B, and creating status 5 and 6 to address the previous status 2. With this reconstructed framework, patients are assessed with regard to the severity of sickness, and position alterations are made based on individual circumstances. For example, on the previous framework, a patient on venoarterial extracorporeal membrane oxygenation (VA-ECMO) and a stable patient using their Elective 1A 30 days were placed in the same tier; however, on the new system, they are assigned to status 1 and 3, respectively. Moreover, a range of 500 nautical miles between the donor and patient hospitals was established to prioritize illness severity instead of geographical proximity [13].

Studies examining the impact of the UNOS heart allocation policy vary in waitlist outcomes among all patient types. Four studies demonstrated statistically improved waitlist outcomes. Bravo-James et al. noted the framework’s impact on adults with congenital heart disease (ACHD) stating similar results among ACHD and non-ACHD patients. Additionally, results indicated increased post-transplant mortality among ACHD patients compared to non-ACHD before the change (n=6172 ;p=0.045), however, this difference became statistically insignificant with the modified system [14]. Jani et al. performed a similar study identifying an increase in the cumulative frequency of transplantation among ACHD patients with shorter waitlist times, demonstrating significant benefits for these patients [15]. In a study examining all transplant recipients, results depicted a reduction in waitlist times with averages of 134.5 and 55.4 days before and after the policy change, respectively. Subsequently, waitlist mortality increased, and post-transplant survival decreased [8]. Additionally, Vaidya et al. analyzed the rejection risk on all patients pre- and post-change, identifying improved access to transplantation for higher acuity patients with no increase of post-transplant mortality [16].

However, other research has demonstrated results that did not improve with the 2018 framework. One study examining waitlist outcomes in ACHD patients found a lack of improvements that was insignificant in terms of waitlist time, post-transplant mortality, and delisting when comparing pre- and post-policy change [17]. Furthermore, Kelty et al. noted a significant lack of improvement in waitlist outcomes among different socioeconomic (SES) groups. The modified system provided increased access to transplantation among all groups, however, low SES groups demonstrated increased death/delisting with a decrease in post-transplant survival [18, 19].

Research also reported mixed waitlist and post-transplant outcomes for all patients (n=3), however, all studies lack significance regarding waitlist improvements. Goff et al. noted that waitlist mortality and post-transplant survival remained unchanged. They indicated that while waitlist mortality was low prior to the policy change, improvements in outcomes are multifactorial with differences accounted for by factors that may or may not relate to the allocation modification [7]. Furthermore, Bradbrook et al. found that the median time to transplantation decreased for all groups, however, no difference in patient survival was found one year after transplant; 91.3% survival rate corresponds to pre-change, whereas post-change is 91.8% [20]. Patel et al. also demonstrated insignificant mixed results, stating that the reason for variance may be multifactorial [20]. The variation in results calls for further assessment.

Figure 3 notes improvements following the UNOS 2018 policy implementation in 4 studies conducted. While the review identifies an increase in improvement following the policy change, research notes areas for advancements, critiquing the efficacy of the current system. One study depicts a requirement for increased prioritization for blood group O patients following an analysis demonstrating worse waitlist outcomes [21]. Additionally, a commentative article by Colvin & Mancini stress the potential impacts of the omission of post-transplant survival consideration within the risk assessment framework. They also note an increase in exception requests which may result from an increase in MCS devices, particularly in status 2. The high urgency categories, such as the prioritization of those on VA-ECMO, remain debated as post-transplant outcomes may worsen [22]. Thus, UNOS should consider applying critiques to enhance patient transplant outcomes.

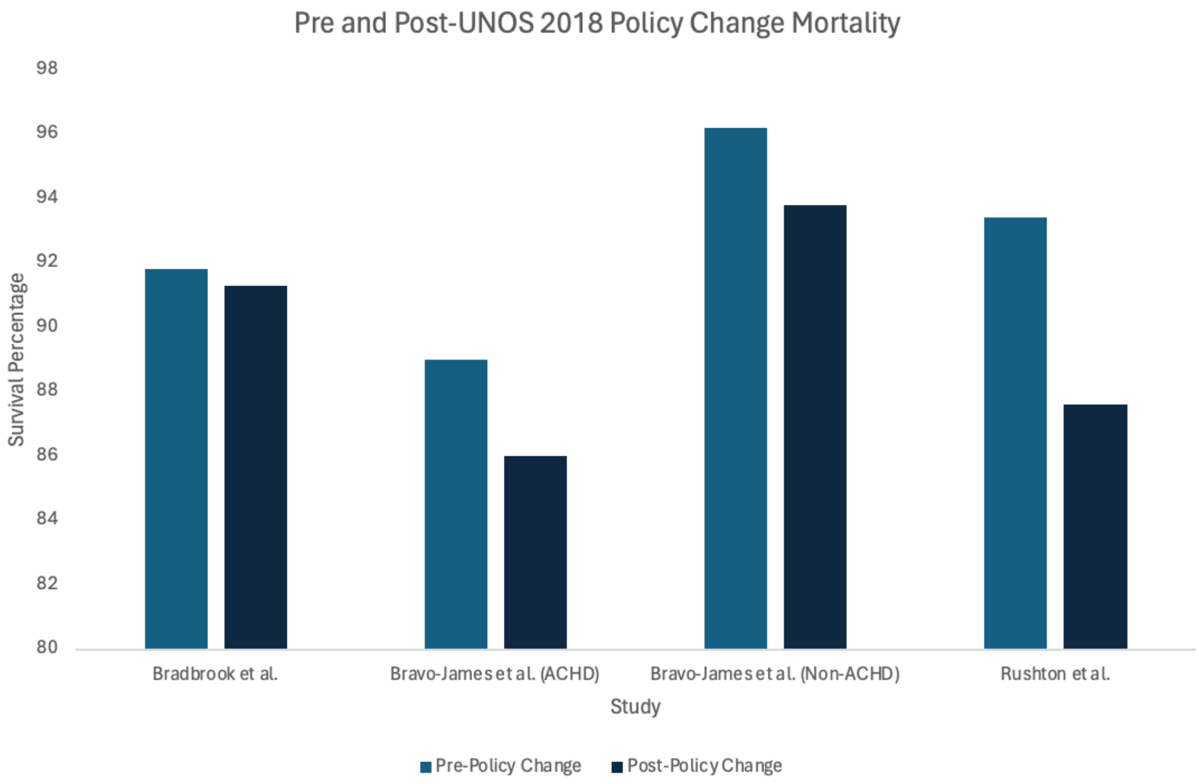


Figure 3. Pre- and post-UNOS 2018 Policy Change Mortality. Reported survival percentage before and after the implementation of the UNOS adult allocation system. Graphs were created using Microsoft Excel.

2016 UNOS Pediatric Heart Allocation Policy

The UNOS Pediatric heart allocation policy, a subset of the current UNOS heart allocation system, was implemented in 2016. They aim to provide youth priority to decrease pediatric transplant wait times and improve waitlist outcomes. Urgency tiers include 1A, 1B, and 2. The framework identifies patient risk according to the highest tier, blood type matching, and ischemic times (the amount of time an organ is chilled without receiving a blood supply) [23].

While limited studies exist examining framework efficacy, results in existing research vary. One study on patients with dilated, restrictive, or hypertrophic cardiomyopathy, congenital heart disease (CHD), and graft failure found a significant lack of improvement in waitlist outcomes. Results identified that status 1A waitlist times were shorter for patients of non-O blood type with an average wait time of 80 days, compared to 108 days for blood type O patients [23]. Moreover, Magnetta et al. demonstrated an insignificant lack of improvement outcomes for patients with CHD and cardiomyopathy; while wait times for status 1A candidates decreased, a higher proportion of remaining individuals had CHD with no changes in waitlist mortality [24]. The lack of positive waitlist outcomes may suggest that youth priority is not adequately significant to produce substantial variation in experiences; therefore, ensuring youth prioritization is critical to enhance the quality of care. Moreover, these outcomes underscore a need for further, updated research.

French Heart Allocation System

The French heart allocation scheme outlined by the Agence de la biomédecine was implemented in January 2018 to address the previous system's shortcomings. These include over-prioritization of high-urgency transplant candidates, inefficient matching of donors and recipients, and the lack of focus on post-transplant patient outcomes. The new framework designates scores based on four steps: the Candidate Risk Score (CRS), patient exceptions, patient-donor matching, and a final consultation to avoid long ischemic times. The highest scores depict the patients at the highest risk and most viable for a heart transplant [25]. The first step, the CRS model, aims to predict the risk of patient death to provide prioritization to the sickest patients; this is based on the eGFR, total bilirubin, B-type natriuretic peptides, and ongoing VA-ECMO support [26]. The second step identifies specific patient exceptions such as candidates with durable MCS-related complications; children with exceptions received higher scores. The following step examines donor-recipient matching through age, blood type, morphology, and mutual risk. Lastly, a final score is given to highlight minimal ischemic times [25].

Research (n=2) varies in reported efficacy and outcomes of the policy. Researchers depicted significant impacts on post-transplant mortality and survival. Quartile 1 of the policy demonstrated low access to transplantation at 58.2% with a waitlist mortality rate of 9.9%; alternatively, quartile 4 demonstrates a transplantation rate of 74.1% and waitlist mortality >20% [27]. The number of categories influenced waitlist outcomes, depicting that thorough, specified prioritization steps benefit positive outcomes. Desiré et al. (2023) also assessed this efficacy and found mixed results. While the average waitlist time was reported as 20.4 days, there were no significant impacts observed regarding patient survival post-transplantation [28]. These varying findings suggest that patient environments may influence waitlist outcomes.

Swiss Organ Allocation System (SOAS)

The SOAS was established in 2007 and is run by the Federal Office of Public Health, aiming to enhance equity when allowing the Swiss transplant to allocate organs. The framework consists of four criteria: medical urgency, medical benefit, equality of opportunity, and time spent on the waiting list. Patients must also demonstrate Swiss residency. For urgent patients, the rest of the criteria is considered with multiorgan transplantation priority in tandem with blood group and waitlist time. For non-urgent patients when the donor and recipient are under the age of 16, the criteria are considered. If one group is above the age of 16 at minimum, the benefits will be weighed with successful candidates following the criteria. Patients in urgent status are of the highest medical urgency and fall under one of the following criteria: the patient is in an intensive care unit requiring vasotropic support, suffers from complications following ventricular assist device implantation, experienced acute graft rejection, or have a similarly poor prognosis [29].

One study demonstrated that the SOAS did not improve waitlist outcomes. Additionally, the waitlist mortality was 19.0%; the age group over 60 depicted mortalities at 31.8% and those 26 to 40 years of age at 10.3% [29]. As only one study assesses outcomes, an increase in research will benefit system comprehension. Regardless, the SOAS requires modification to adequately cater to patients.

UK Heart Allocation Policy

The United Kingdom's heart allocation policy was reviewed in 2016; previously, two categories existed, non-urgent and urgent, but the recent addition of the super-urgent category aimed at prioritizing adult patients on temporary MCS to decrease patient wait times (30). The reviewed policy framework categorizes patients into adult, pediatric, and small adults. Pediatric patients are under the age of 16. Small adult patients weigh less than 30 kg or between 30 kg to 40 kg and require panel agreement. Following is an assessment of transplant urgency, blood group compatibility, patient-donor size compatibility, waitlist times, same allocation zones, and patient offering orders [31].

Research (n=1) depicted a significant improvement in median transplant wait times. In era 1, the times were 41 days for total urgent transplants; alternatively, era 2 demonstrated 17 days for super-urgent and 71 days for urgent. There was no significant impact on non-urgent transplants. Waitlist mortality also decreased from 5 to 2% with no difference in the number of temporary MCS patients; post-transplant survival was unaffected [30]. This finding emphasizes the efficacy of the UK heart allocation policy; however, generalizability will benefit from increased research as this study only assessed January 2017 to December 2018.

Policy Comparisons

Each study regarding the heart allocation policy assessed a different set of outcomes. The nine studies regarding the UNOS heart allocation policy identify a variation in results regarding general outcomes and efficacy. A standardized set of research outcomes is recommended to increase the comprehension of its efficacy. Additionally, the two studies analyzing the 2016 UNOS identified significant and insignificant improvements in waitlist outcomes. The two studies examining the 2018 French heart allocation policy identified mixed results regarding waitlist outcomes. The UK heart allocation policy and Swiss policy each had one article assessing outcomes; the outcomes were statistically improved and not improved, respectively. Therefore, with varying outcomes assessed, differences in the time frames of conducted studies, varying sample sizes, different populations assessed, and generally limited research examining each heart allocation policy, a significant statement cannot be made regarding policy efficacy and comparisons. Therefore, the authors advise that researchers identify key outcomes to assess within global research to correctly identify areas of success. Factors like wait list time provide an indicator of both mortality and overall patient outcome serving as a valuable characteristic when assessing the effectiveness of a given allocation system. A standardized determination of outcomes including waitlist times and mortality would allow for a comprehensive analysis regarding the advantages and disadvantages of implementing each policy framework on patient outcomes.

Limitations

The analysis comprises various limitations that may prevent result accuracy. Nearly all studies assessed were retrospective cohort studies, involving various healthcare professionals in the patients' care; subjectivity of patient outcomes in database information may present inconsistencies. Additionally, there was an insufficient availability of research regarding each policy, limiting the depth of analysis and comparison.

Various research avenues can be considered to increase the comprehension of allocation policy methods. Research should continue to examine the impacts on pediatric populations for all policies. They may also address disparities faced by patients with CHD and cardiomyopathy, analyzing specific post-transplant impacts through a longitudinal study. Global heart allocation networks are encouraged to publish data analyses with specific experiences regarding their allocation policies. Using this data, a broad comparison of global allocation efficacy can be conducted with distinct suggestions provided per policy. Furthermore, addressing study limitations and pursuing the next steps may influence policy changes, thereby enhancing the quality of life for patients requiring heart transplants.

Conclusions

In conclusion, prioritizing positive waitlist outcomes for patients requiring heart transplants is critical to enhancing the quality of care for vulnerable populations. This study's thorough examination and interpretation of the 2018 UNOS heart allocation framework, the 2016 UNOS Pediatric policy, the French heart allocation scheme, the SOAS, and the UK heart allocation policy underscores the importance of establishing specified frameworks that organize donations with the most effective organ matching. Results highlight various areas of continued research such as in pediatric populations and individuals with temporary MCS across various frameworks; additionally, with the recent advancements in artificial intelligence technology, exploring its potential integration within heart allocation frameworks may benefit researchers in improving patient outcomes and optimizing overall transplant management. Moreover, heart allocation networks globally must be prompted to report patient outcomes to assist in informing policy changes and enhance positive transplantation experiences.

List of Abbreviations Used

UNOS: united network for organ sharing
OPTN: organ procurement & transplantation network
KAS: kidney allocation system
PRISMA: preferred reporting items for systematic reviews and meta-analyses
JBI: joanna briggs institute
SOAS: swiss organ allocation system
MCS: mechanical circulatory support
VA-ECMO: venoarterial extracorporeal membrane oxygenation
ACHD: adults with congenital heart disease
SES: socioeconomic
CHD: congenital heart disease
CRS: candidate risk score

Conflicts of Interest

The authors declare no conflicts of interest in the conceptualization or writing of this article.

Ethics Approval and/or Participant Consent

Ethics approval was not required for the study as it was a review rather than direct involvement with human participants.

Authors' Contributions

RS: made contributions to the conceptualization of the study, the study design, data collection, data extraction, manuscript draft, and provided final approval of the version to be published. RS agrees to be accountable for all aspects of the manuscript.

SI: made contributions to the study design, data collection, data analysis, data interpretation, manuscript draft, and provided final approval of the version to be published. SI agrees to be accountable for all aspects of the manuscript.

DC: made contributions to the study design, data collection, data analysis, data interpretation, manuscript draft, and provided final approval of the version to be published. DC agrees to be accountable for all aspects of the manuscript.

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