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## A Review of Racial, Socioeconomic, and Geographic Disparities in Pediatric Liver Transplantation

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### Abstract

Equity is a core principle in both pediatrics and solid organ transplantation. Health inequities, specifically across race, socioeconomic position, or geography, reflect a moral failure. Ethical principles of prudential life span, maximin principle, and fair innings argue for allocation priority to children related to the number of life years gained, equal access to transplant, and equal opportunity for ideal post-transplant outcomes. Iterative policy changes have aimed to narrow these disparities to achieve pediatric transplant equity. These policy changes have focused on modifying pediatric priority for organ allocation to eliminate mortality on the pediatric transplant waitlist. Yet disparities remain in pediatric liver transplantation at all time points: from access to referral for transplantation, likelihood of living donor transplantation, utilization of exception narratives, waitlist mortality, and inequitable post-transplant outcomes. Black children are less likely to be petitioned for exception scores, have higher waitlist mortality, are less likely to be the recipient of living donor transplant, and have worse post-transplant outcomes compared to White children. Children living in the most socioeconomically deprived neighborhoods have worse post-transplant outcomes. Children living further from a transplant center have higher waitlist mortality. Herein, we review the current knowledge of these racial and ethnic, socioeconomic, and geographic disparities for these children. To achieve equity, stakeholder engagement is required at all levels from providers and health delivery systems, learning networks, institutions, and society. Future initiatives must be swift, bold, and effective with the tri-partite mission to inform policy changes, improve healthcare delivery, and optimize resource allocation to provide equitable transplant access, waitlist survival, and post-transplant outcomes for all children.

### Keywords

Health equity; racism; advocacy; policy; pediatric liver transplantation

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## Introduction

Through the history of pediatric solid organ transplantation, several milestones have narrowed transplant disparities. In 1984, the National Organ Transplant Act established a national system to improve the matching process between organs and individuals to achieve a more equitable organ allocation system. However, organs continued to be distributed regionally, potentially to registrants with lower medical acuity. Therefore, in 2000, the Final Rule aimed to improve geographic disparities and prioritize organ allocation to waitlist registrants with the highest medical acuity. In 2002, the Pediatric End-Stage Liver Disease (PELD) scoring system was implemented, with the aim to provide an objective scoring system to predict pediatric waitlist mortality. However, in comparison to adults, the PELD score did not adequately assess the risk of waitlist mortality for children and has not been modified since its inception.<sup>1-3</sup> In 2005, the United Network for Organ Sharing (UNOS) allowed for standardized exceptions to account for mortality risks not captured by the natural Model for End-Stage Liver Disease (MELD)/PELD score. In 2019, non-standard exception requests (i.e., narratives written by transplant programs to describe medical acuity not captured by the natural MELD/PELD score) transitioned from review by 11 Regional Review Boards to one Pediatric National Liver Review Board (NLRB) to ensure these requests were reviewed by hepatologists and transplant surgeons with pediatric expertise. Despite these changes, children remained disadvantaged on the waitlist with a proportion of pediatric organs being allocated to adults over children and natural PELD scores continuing to underestimate a child's risk of waitlist mortality.<sup>4</sup> In 2020, acuity circles were implemented to prioritize deceased donor pediatric livers to children nationally before being offered to adults within a 500 nautical mile acuity circle. Despite these changes to benefit the pediatric liver transplant registrant, in 2019, 3.9% of pediatric registrants died on the waitlist and 2% were removed for being too sick to transplant.<sup>5</sup> Furthermore, post-transplant outcomes remain suboptimal: after transplant, only 1/3 of children attain an "Ideal Outcome" (e.g., a functioning allograft with no immunosuppression comorbidities).<sup>6</sup>

The organ allocation system itself must balance the ethical principles of utility, equity and justice. Utility maximizes the net good and beneficence over an alternative action that imposes harm or maleficence; in other words, it prioritizes the greatest good. The ethical principle of utility, for example has argued for pediatric prioritization in organ allocation due to the superior survival of children and their number of life years gained. Yet there must be ethical equipoise in transplantation between utility and equity. The principles of equity and justice have to do with the fair distribution of the benefits and burdens of organ transplantation, such that no individual or group of individuals receive a greater proportion of the net good. Additionally, social aspects of utility, such as a determination of an 'individuals worth', have no role in organ transplantation. The Organ Procurement and Transplantation Network (OPTN) Ethical Principles in the Allocation of Human Organs states, "it is unacceptable to use variations in transplant outcomes among social groups as a basis for predicting individual outcome."<sup>7</sup> While justice and equity remain core ethical principles in organ allocation, disparities remain.

As we examine equity in pediatric transplantation, we aim to describe how racial and ethnic, socioeconomic, and geographic drivers of disparities lead to inequitable outcomes. Every

member of a multidisciplinary transplant hepatology and surgery team must understand the contribution of systemic racism, bias, and the social determinants to a child's health. Without this understanding, equal health outcomes cannot be achieved, and children and families remain disempowered by systems: with unequal access to fair and affordable housing, education, healthy foods, transportation, and other social predictors of health.<sup>8</sup>

While historic policy changes have worked to prioritize children for transplant allocation and have improved geographic and age disparities, they have not directly targeted pediatric racial and ethnic and socioeconomic disparities. Furthermore, while the OPTN Minority Affairs Committee aims to address disparities in solid organ procurement, allocation, and transplantation for minority and vulnerable populations, no current federal policy or national regulatory body committee exists to address post-transplant disparities specifically for children. The Society of Pediatric Liver Transplantation (SPLIT) Advocacy Committee and the Starzl Network are comprised of powerful advocates including pediatric transplant hepatologists and surgeons, with the mission to improve pediatric transplant disparities via research, policy, and UNOS Public Comment efforts. Still, disparities persist, which policy changes alone have been unable to eradicate. Moreover, policy-based solutions may at times, such as in the case of non-standard exception requests, introduce bias and subjectivity and further widen disparities.

The social determinants of health are the economic and social conditions that influence the health of people and communities and include the domains of: neighborhood and built environment, social and community context, education access and quality, economic stability, and healthcare access and quality.<sup>7</sup> The social determinants of health include racism, discrimination and violence, medical literacy, housing stability, transportation, childcare, and food insecurity.<sup>9</sup> In this review, we utilize concepts from ethics and public health paired with an examination of pediatric national registry studies to describe the current state of racial and ethnic, socioeconomic, and geographic pediatric liver transplant disparities. We additionally put forth novel potential strategies to mitigate these disparities.

## Racial and Ethnic Disparities

### Referral and listing for transplantation

Racial and ethnic disparities exist at every phase of pediatric liver transplant. In the pre-transplant period, Black and Hispanic children have a significantly increased sub-hazard of waitlist mortality compared to White children, even after adjusting for neighborhood deprivation. Both Black and Hispanic children also have higher initial and final lab PELD/MELD scores compared to White children, suggesting a potential delay in referral, or listing and a delay in receipt of liver transplantation.<sup>10</sup>

One potential contributor to these waitlist disparities may be through the inequitable use of non-standard exception requests (NSER), which offer a survival benefit. In 2019, 75% of pediatric transplant recipients had an exception score at the time of transplant.<sup>5</sup> However, Hsu, et al. demonstrated that children of non-White race, including Black, Hispanic, Asian, American Indian/Alaska Native, Native Hawaiian/Other Pacific Islander, and multiracial children, had 13% lower rates of exception score requests submitted by the transplant

team.<sup>11</sup> The benefit to the registrant for NSER request is significant, as the majority of NSER requests are approved. Braun, et al. reported that children with NSER approvals had an increased hazard for liver transplant and children 2-18 years old with NSER denials had a higher risk of waitlist mortality. Children with NSER approval additionally had a decreased risk of graft loss and those with NSER denial had a higher risk of post-transplant death.<sup>12</sup> While NSERs are necessary to account for illness severity not captured by natural PELD/MELD scores, its non-standardized process allows for individual or group bias on the decision to petition a registrant, what score to request, and how often to petition; non-White children are disadvantaged in this process.<sup>13</sup>

Another potential contributor to waitlist disparities may be differential access to living donor liver transplantation (LDLT). Superior graft and patient survival have been described in pediatric LDLT compared to deceased donor liver transplantation.<sup>14-16</sup> In 2019, 14% of pediatric liver transplant registrants underwent LDLT, but this was not further stratified by race or ethnicity.<sup>5</sup> For Black children, Mogul, et al. found a reduced incidence of LDLT (sub hazard ratio 0.56) compared to White children utilizing Scientific Registry of Transplant Recipients (SRTR) data.<sup>17</sup> Wadhvani, et al. similarly reported that Hispanic and Black children were about half as likely to undergo LDLT compared to White children.<sup>10</sup> In adults, Black registrants also receive a disproportionately lower percentage of LDLTs. Insurance coverage may limit the potential living donor applicant. While the costs of living donation are billed to the recipient's health insurance, the living donor is often required to have their own independent health insurance for medical issues arising before or after donation. Black and Hispanic adults are also more likely to have diabetes and hypertension compared to white adults.<sup>18</sup> Both insurance and chronic medical condition barriers to LDLT are rooted in systemic racism as a driver of these health inequities. This inequality in rates of LDLT for children may contribute to longer waitlist times, higher waitlist morbidity and mortality, and worse post-transplant graft and patient survival.

### Post-transplantation

Racial and ethnic disparities continue to persist in the post-transplant period. Thammana, et al., in a single center study of liver transplant recipients aged 0-22 years, found that, compared to White children, Black, Hispanic, Asian, American Indian/Alaska Native, Native Hawaiian/Other Pacific Islander, and multiracial children had 2-3 times higher graft failure rates and 3 times higher death rates.<sup>19</sup> Wadhvani et al. similarly found that Black children had an increased risk of death compared to White children, even after adjusting for neighborhood deprivation.<sup>20</sup>

Even for non-White children that survive after liver transplantation, they carry an increased risk of significant morbidity. Ng, et al., developed a composite outcome measure of morbidity and found that only 1/3 of pediatric liver transplant recipients have an ideal outcome at 10 years post-transplant, which was defined as: being alive, with ALT <50 or GGT <50, normal glomerular filtration rate, no cytopenias, no post-transplant lymphoproliferative disorder and no need for non-liver transplantation.<sup>6</sup> In a follow-up study, a machine learning analysis of 76 demographic, allocation, and disease-specific

variables found that non-White race was the single most important predictor that a child would fail to attain an ideal outcome 3 years after liver transplant.<sup>21</sup>

As we consider the underlying causes for these racial and ethnic disparities, we must call attention to the large body of social science literature documenting that race is a social construct and not a biologic or genetic construct.<sup>22–24</sup> Therefore, observed racial disparities must be interpreted in the context of historical and ongoing racism. Racism exists in many forms and includes structural and interpersonal racism. Structural racism may be defined as ‘the totality of ways in which societies foster racial discrimination via mutually reinforcing and inequitable systems that in turn reinforce discriminatory beliefs, values and the distribution of resources reflected in history, culture, and interconnected institutions’.<sup>25</sup> One example of structural racism that limits opportunities and shapes the distribution of money, power, and resources is residential segregation. ‘Redlining’ was introduced in the 1930s by the Home Owners’ Loan Corporation and used geographic maps to grade areas as more or less desirable, encouraging lending to predominately White areas.<sup>9,26</sup> Residential racial segregation directly relates to population and individual health inequities with preterm births and cancer, for example, having higher incidence amongst residents in previously red-lined areas.<sup>27</sup> Individual or interpersonal racism describes a ‘socially structured action that is unfair or unjustified’ based on race or ethnicity. An example being an individual in an institutional role such as a health care provider offering sub-standard care to a patient based on their race.<sup>9</sup> The effects of racism are pervasive in society and in medicine, leading to unequal healthcare at both the population and individual level for children undergoing liver transplantation. Dismantling structural racism requires first understanding how a long history of racism in the United States harms health, to next engage in change at the individual, institutional, and policy levels.

## Socioeconomic disparities

Neighborhood socioeconomic deprivation indices, specific to a child or family’s home address or ZIP code, contextualize the economic milieu of a child’s neighborhood. One neighborhood socioeconomic deprivation index that has been used in pediatric liver transplant incorporates 6 variables from the United States Census Bureau: the percentage of households below the federal poverty level, percentage of adults with high school educations, percentage of individuals without health insurance, percentage of households receiving public assistance, percentage of vacant housing units and median household income. This index is available for every census tract (i.e., neighborhood) in the United States and ranges from 0-1, with increasing values equating to increased deprivation.<sup>28–30</sup>

Neighborhood socioeconomic deprivation alone, however, may not fully capture an individual registrant or recipients’ health-related social needs. Eligibility for Medicaid also varies across states, and private insurance coverages varies; therefore, insurance status alone may not serve as a sufficient variable. Furthermore, it remains unclear whether Medicaid insurance itself is a proxy measure for other unmeasured social needs. Thus, we acknowledge that while these measures have contributed to our collective understanding of the socioeconomic disparities in pediatric liver transplant, future work is needed to achieve equitable outcomes across socioeconomic position.<sup>10</sup>

## Referral and listing for transplantation

Neighborhood socioeconomic deprivation has been associated with adverse outcomes across the spectrum of pediatric liver transplantation. Starting at waitlist entry, in unadjusted analyses, each 0.1 increase in the deprivation index was associated with a 9% increased sub-hazard of waitlist mortality.<sup>20</sup>

## Post-transplantation

Neighborhood deprivation is also associated with post-transplant outcomes. Leveraging the Medication Adherence in children who had a Liver Transplant (MALT) cohort, Wadhvani et al. investigated whether deprivation was associated with medication non-adherence using the Medication Level Variability Index (MLVI), an objective biomarker of non-adherence.<sup>31</sup> They found that pediatric liver transplant recipients living in the highest (most deprived) neighborhood deprivation index quartile were twice as likely to be nonadherent to immunosuppressive medications. Using SRTR data, the same group found that neighborhood deprivation was associated with an increased risk of graft failure and death over a 10-year timespan after transplant.<sup>20,28</sup> In a follow up study, Wadhvani et al. sought to determine if there was a differential effect of deprivation on adverse outcome by transplant center and found that as the proportion of patients from socioeconomically deprived neighborhoods increased for a center, patients had a 32% increased hazard of graft failure. However, they found that center quality, as measured by the center level graft survival rates, was an important confounder. High-performing pediatric liver transplant centers were able to achieve good long-term post-transplant outcomes despite caring for predominately socioeconomically deprived children.<sup>32</sup> This study demonstrated that while socioeconomic deprivation is a risk factor for adverse outcomes, there may be transplant center practices that mitigate the risks of socioeconomic deprivation. In addition to socioeconomic deprivation, insurance has additionally been used as a proxy for socioeconomic status. Dick et al., utilizing the UNOS database, found that children less than 18 years old with Medicaid insurance had a relative risk of 1.42 of post-transplant mortality; further demonstrating that socioeconomic position impacts transplant outcomes.<sup>33</sup>

## Geographic and regional disparities

There have been historical and substantial geographic disparities in the United States, partly due to organ allocation practices. Prior to 2020, when an organ became available, it was first offered to the waitlist registrant at the top of the list who resided within the same donor service area (DSA). DSAs are geographically segmented portions of the United States that were created to facilitate organ allocation. However, given their varying sizes, shapes, and populations, they did not serve as good proxies for the geographic distance between donors and transplant registrants. Because this violated the Final Rule, which aimed to improve geographic disparities and prioritize organ allocation to waitlist registrants with the highest medical acuity, the acuity circle policy replaced DSA boundaries for organ distribution in February 2020. The acuity circle policy removed references to DSAs and regions and instead allocated organs based on the recipient's allocation score and their distance from the deceased donor hospital by increasing increments of 150, 250 and 500 nautical mile circles.<sup>4,34</sup> The acuity circle policy additionally prioritized deceased donor pediatric livers

to pediatric registrants nationally before being offered to adults within a 500 nautical mile acuity circle. Mogul, et al. applied SRTR data to a Liver Simulated Allocation Model, comparing acuity circle allocation to the DSA/region-based allocation system and found that acuity circle allocation will likely improve pediatric liver transplant geographic disparities by decreasing pediatric waitlist mortality.<sup>4</sup> Given its recent implementation, assessment of whether this policy improves pediatric geographic disparities is ongoing.

### Referral and listing for transplantation

Other sources of geographic disparities include distance to care. Adler, et al. reported that children who lived >200 miles from their listing transplant center had a 75% higher risk of waitlist mortality. They also found that these children had higher PELD/MELD scores at the time of listing, possibly reflecting a delay in referral or listing for liver transplant.<sup>35</sup>

Finally, there remains substantial geographic variation in how NSERs are utilized. In 2017-2019, variation in the use of NSERs by DSA ranged between 28-100%.<sup>5</sup> Additionally NSER denial between 2009-2014 varied by region, though this regional disparity may potentially be mitigated by the transition to a NLRB in 2019.<sup>12</sup>

## Addressing Disparities in Pediatric Liver Transplantation

### Current interventions

A collective movement to equalize outcomes for pediatric registrants and recipients requires a common language across the transplant community. Specifically, it requires an understanding of the social determinants of health to identify pediatric registrants and recipients in whom more intensive resources should be deployed to ensure equitable care and outcomes. Screening for and addressing a child and family's social needs leads to improved health.<sup>36</sup> Important interventions at pre- and post-liver transplant clinic visits in partnership with liver transplant social workers might include screening for adverse social determinants of health. Multiple social determinants of health screening tools are available and may be verbal, written, or embedded in the electronic medical record.<sup>37</sup> Addressing a patient and family's basic needs including housing, food security, and transportation may help to improve quality of life, and short- and long-term transplant outcomes in pediatric liver transplant recipients.

Consideration for interventions from other chronic illness models include the Novel Interventions in Children's Healthcare (NICH) program at both the Oregon Health & Science University, Stanford University, and the University of California, San Francisco, which utilizes a resource intensive long-term case management model with a dedicated interventionist for children with chronic medical conditions and social barriers to health; this provides a time intensive but potentially replicable model to improve patient-level outcomes.<sup>38</sup>

Additional institutional pre-transplant improvement initiatives may include the identification of racially and ethnically diverse parent mentors including Spanish speaking mentors or navigators for families during the transplant evaluation process, and standardizing living donor liver transplant conversations with families with paired adult parent advocates. Use of



a living donor advocate has previously been described in the renal transplant literature, with an increase in the incidence of living donor renal transplantation compared to a control group.<sup>39</sup> The Northwestern Medicine African American Transplant Access Program, founded and led by transplant surgeon, Dr. Dinee Simpson, is an impactful example of a destination program that prioritizes equal access to excellent care for African American patients with liver or kidney disease.<sup>40</sup>

To address center-level geographic disparities, telehealth technology could be more expansively deployed to bridge certain geographic barriers.<sup>41</sup> The utility of telehealth visits for the appropriate transplant registrant or recipient in addition to in person visits may potentially help to mitigate some of these geographic disparities.

### Proposed interventions

Multidisciplinary hepatology and transplant teams and pediatric transplant societies must address the role that racism and bias play in differential transplant outcomes. Perturbations in global health and economy have only further widened these racial and ethnic health disparities.<sup>42</sup> Racial health inequities should not be attributed to ‘unmeasured genetic or biological factors’ or patient mistrust.<sup>43</sup> Stigmatizing, biased and racist language must be removed from the health care setting.<sup>44</sup> As one proposed intervention, in 2021, SPLIT and The Transplantation Society launched an ongoing webinar series, ‘Effective Communication in Addressing Racial Bias: A Breaking Through Workshop’ with Dr. Hannibal Person to bring pediatric transplant hepatologists, surgeons, trainees and other transplant team members together to eliminate racism and bias in pediatric liver transplantation.

Furthermore, an assessment of an individual’s social determinants of health and their neighborhood socioeconomic deprivation index should not be used as a punitive measure at any phase of transplant. As one example, the aim of the social assessment during liver transplant evaluation should be for the multidisciplinary team to recognize the holistic environment in which a child lives and be presented with the aim to eradicate barriers that prevent an ideal pre- and post-transplant outcome, not utilized to delay listing for a patient or as an assumed barrier to LDLT.<sup>6</sup> Other examples of pre-transplant improvement initiatives include creating an objective framework for timing to petition for exception points to eliminate subjective bias as well as a standardized approach to presenting LDLT education during the transplant evaluation process.

Ideal and equitable care for diverse patient populations also requires a diverse workforce.<sup>45,46</sup> Cultural competency training alone has not been shown to improve patient outcomes.<sup>47</sup> Between 2015-2019, only 1 of 43 pediatric transplant hepatology fellowship graduates was African American (3%) and 4 were Hispanic/Latino (11%).<sup>48</sup> Only 5.5% of transplant surgeons are Black and 8% are Hispanic.<sup>49</sup> Prioritization on the recruitment and retention of diverse multidisciplinary teams are needed to provide the highest quality of care to the diverse populations we serve and to best address racial and ethnic health disparities and systemic racism in transplantation.

Pediatric transplant societies must have a zero-tolerance policy for racism and racial health inequities. Leading pediatric, hepatology and transplant journals must create a home

for research related to structural racism and health disparities. Annual transplant society meetings should form abstract categories to solicit, support and promote the next generation of research that captures the gravity that disparate care has on the health of non-White children and the bold innovations needed to eliminate health disparities in pediatric liver transplantation.

Pediatric liver transplant health equity metrics and dashboards that are universally agreed upon, timely, and publicly reported are needed to identify and make transparent disparities in outcomes before and after transplant and to drive the rapid change needed to achieve equitable outcomes for all children. Specifically, the OPTN/SRTR Annual Data Report for pediatric liver transplant should include waitlist mortality and graft and patient survival by demographic indices, specifically by race and ethnicity, socioeconomic indices, and geography to allow for long-term tracking of these critical metrics. Additionally, health equity dashboards should provide near real-time center level SRTR data to track pediatric liver transplant disparities by these demographic indices. This would allow for national benchmarking with the ability to compare and identify high-performing centers.<sup>32</sup> Moreover, pediatric transplant societies should highlight high performing centers, amplified through learning networks such as the Starzl Network and quality improvement initiatives such as through SPLIT to rapidly identify strategies for achieving health equity for all children requiring liver transplant.

Larger policy changes must provide universal and expanded protections for living donors. In 2021, 25% of living donors were rejected or charged higher premiums based on their living donor status. Only 12 states mandated private employers to have job-protected leave and only 2 states provided paid leave through the Family Medical Leave Act (FMLA).<sup>50</sup>

## Conclusions

Despite significant policy-based initiatives to improve pediatric allocation and geographic disparities, racial and ethnic, and socioeconomic disparities still remain unaddressed (Figure 1). Non-White compared to White children are sicker at the time of referral for transplant, have a higher risk of waitlist mortality, are less likely to be petitioned for exception scores, are less likely to be the recipient of LDLT, and are more likely to have graft failure or die after liver transplant. Children living in socioeconomically deprived neighborhoods are more likely to die on the waitlist, have worse medication adherence, and are more likely to have graft failure or die after liver transplantation.

Further large-scale research will help support federal and governing body policy changes and health care delivery to provide equitable transplant access, waitlist survival, and post-transplant outcomes for all children regardless of race or ethnicity, socioeconomic position, or geographic region. However, the cumulative evidence in this review makes clear that individual, institutional, and societal advocacy and improvement initiatives are required in parallel to ongoing research. Currently, non-White and/or socioeconomically deprived children may be listed without an exception score, they may have died on the waitlist, and they may be less likely to attain ideal post-transplant outcomes. The consequences of individual and structural racism and ignoring the adverse social determinants of health, is a

widening of transplant disparities and long-term negative health outcomes. In pediatric liver transplantation, this may be the difference between a child living or dying based on their race or ethnicity, and/or where they live, grow up or play.<sup>51</sup>

Health inequities describe differences in healthcare outcomes that are unjust. It is an undeniable atrocity that a child may be disadvantaged at all phases of transplant related to their race or ethnicity, socioeconomic position, or geographic location. As a call to action, pediatric hepatology and transplant societies and individuals must highlight and prioritize pediatric liver transplant equity with ongoing advocacy efforts to impact policy, address structural racism as a driver of health inequity, and leverage collaborative working groups and learning networks to create meaningful change. Further legislative, societal, institutional, and individual interventions are all required to eliminate pediatric liver transplant disparities (Figure 2). Health equity in pediatric liver transplantation has not yet been achieved and will only occur when all children have equal access to transplant with equal post-transplant outcomes.

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### Abbreviations:

<b>DSA</b>	donor service area
<b>DLT</b>	Living Donor Liver Transplantation
<b>MELD</b>	Model for End-Stage Liver Disease
<b>NLRB</b>	National Liver Review Board
<b>NSER</b>	Non-Standard Exception Request
<b>OPTN</b>	Organ Procurement and Transplantation Network
<b>PELD</b>	Pediatric End-Stage Liver Disease
<b>SPLIT</b>	Society of Pediatric Liver Transplantation
<b>SRTR</b>	Scientific Registry of Transplant Recipients
<b>UNOS</b>	United Network for Organ Sharing

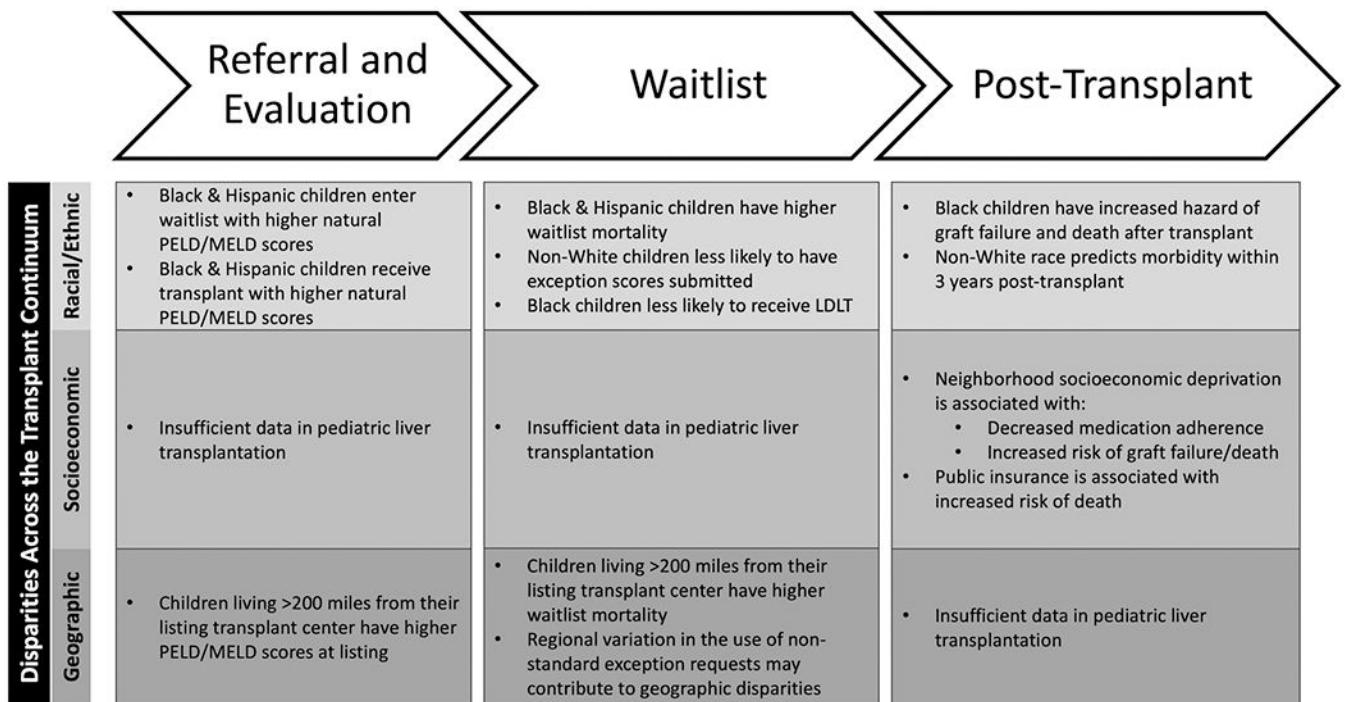
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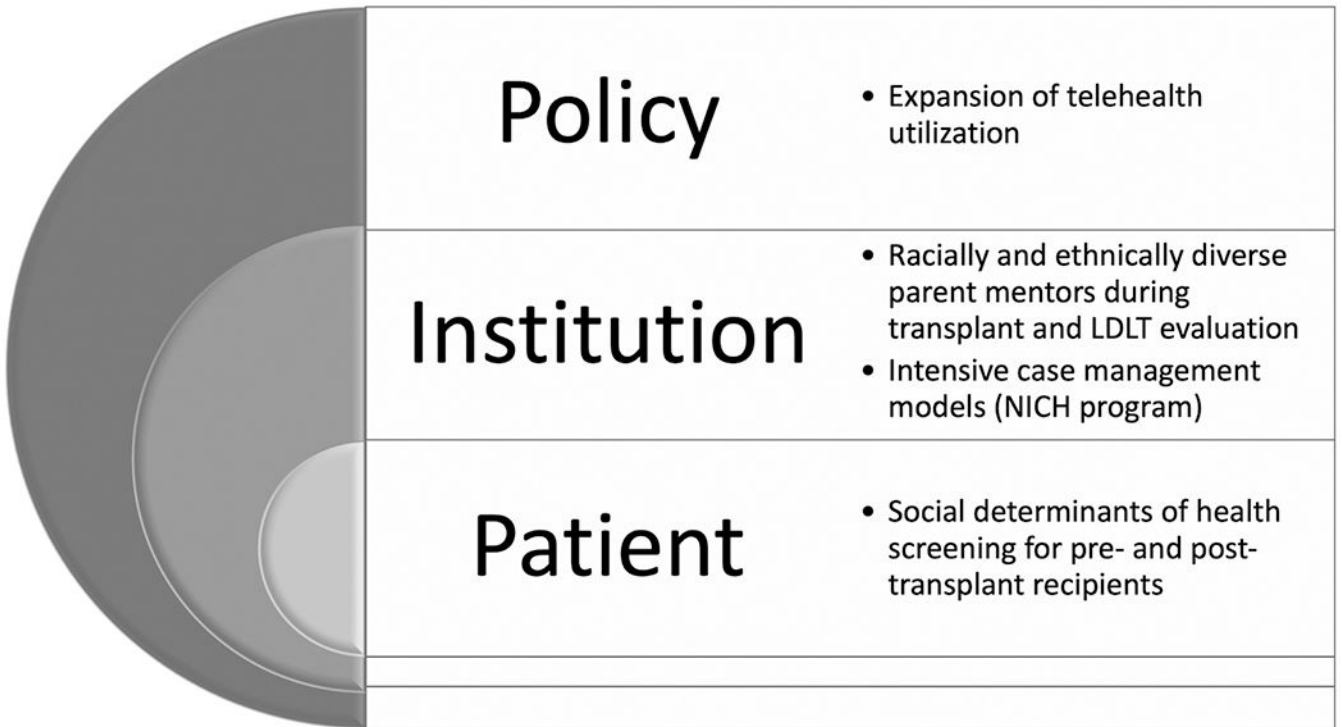
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**Figure 1. Racial, socioeconomic, and geographic disparities across the transplant continuum.**

This figure summarizes our current understanding of the racial, socioeconomic, and geographic disparities across the transplant continuum for children undergoing liver transplantation. Gaps in knowledge are additionally highlighted.

A.



B.

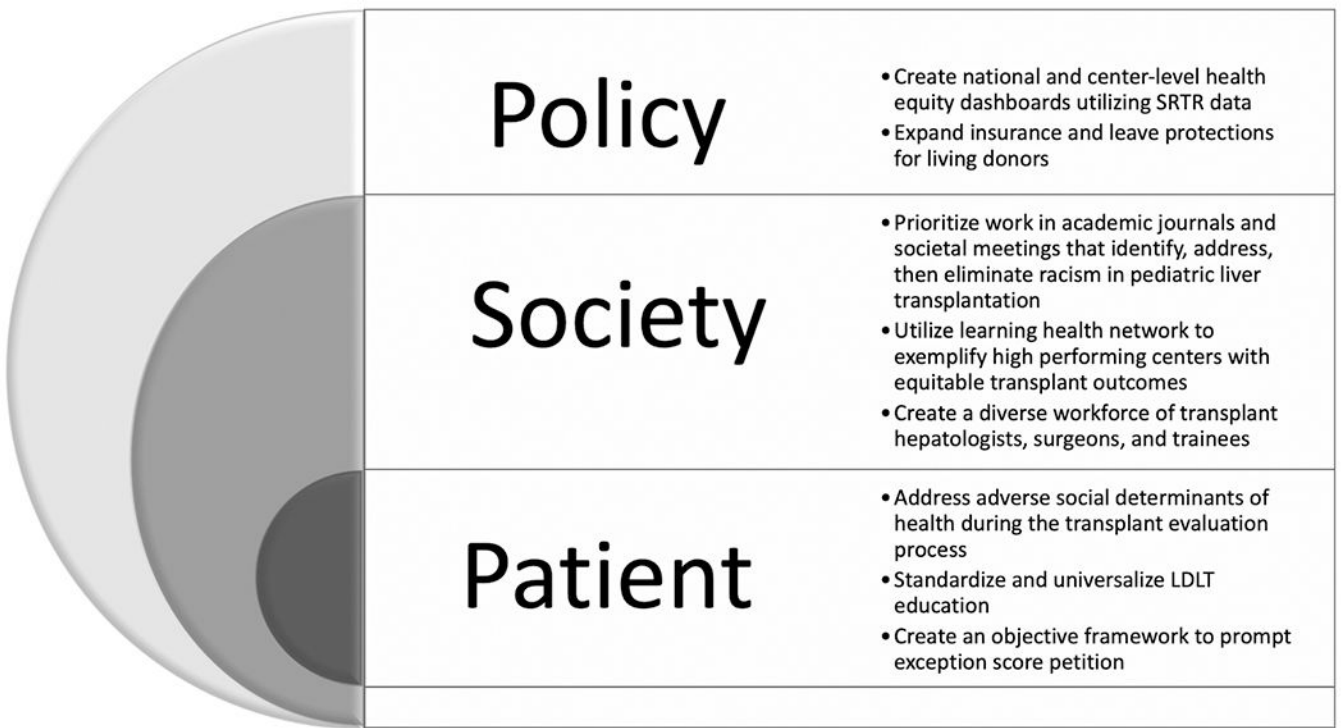


Figure 2.



Addressing disparities in pediatric liver transplantation: A) current interventions B) proposed interventions.

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