



Kidney Allocation System for Transplantation in Brazil

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Abstract

Purpose of Review Worldwide allocation systems are subjected to regulatory and ethical unique themes prevailing under the local socioeconomic and health care system. We sought to describe kidney allocation system, local transplant regulatory environment, and some general information concerning reimbursement in Brazil.

Recent Findings Under a universal health care program, the national transplant system coordinates national transplant activity. Organ procurement occurs through a combination of organ procurement organizations and hospital commissions. Donation after circulatory death is still prohibited. Allocation system is primarily based on HLA compatibility within regional waiting list. In 2017, the number of effective deceased donors was 16.6 per million population (pmp, 23rd in the world) and the number of kidney transplants was 28.8 pmp (33rd in the world). Bundle reimbursements are provided by the federal government for organ procurement and transplantation. Given the wide geographical disparities among the 26 states, performance and outcomes vary considerably.

Summary The combination of late referral, inadequate maintenance, and long cold ischemia time results in high incidence of delayed graft function (60–70%), increases costs, and is associated with inferior long-term allograft survival. Cost-effective strategies have been implemented to increase the number of transplants, reduce delayed graft function incidence, reduce geographical disparities, and improve long-term graft survival.

Keywords Organ donation · Organ procurement · Kidney transplantation · Reimbursement · Organ allocation system

Introduction

Brazil is a continental country with 8,515,767 km² (5th largest country in the world), divided into 26 states and 5570 cities, including Brazilia, the Federal District. Its 209.3 million inhabitants (5th highest population in 2017) comprise one of the most multicultural and ethnically diverse nation, a consequence of

intense immigration and miscegenation. In 2017, the gross domestic product (GDP) adjusted for purchasing power parity was 3.241 trillion dollars (8th highest in the world) [1].

The Brazilian health system is composed of a large public, government-managed system, which provides universal access to health care for the majority of the population, and a private sector, managed by private health care organizations.

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The life expectancy at birth is 76 years, and the mortality rate under 5 years is 15 per 1000 live births.

National Transplant System

In 1997, the National Transplant System (NTS), an organization under the regulation of the Health Ministry, was created to develop and coordinate procurement, distribution, and allocation of organs for transplantation. NTS attributes include registration and accreditation of all transplant centers, regulation of deceased and living donor practices, promotion of education and specialization of professionals, and incentives and funding for the transplant program. The current legislation for organ donation in Brazil recognizes brain death (DBD) under well-defined criteria developed by the Federal Council of Medicine [2]. Notification of potential donors is compulsory, and donation of deceased donor organs relies on family informed consent [2]. Currently, there is no legislation for donation after circulatory death (DCD) and hence, donation of such organs is prohibited. Living donation is strictly controlled allowing related and unrelated donation from spouses and adoptive parents but requiring judicial authorization and approval by the ethics committee of the transplant center and state health secretary for other types of unrelated donors.

Organ Procurement and Allocation

Organ procurement is coordinated by state transplant centers (STC, $n = 27$) located in each of the 26 State Health Secretaries and 01 in the Federal District. The National Transplant Center (NTC), located at the federal district, coordinates interstate organ allocation. Each STC works in concert with regional organ procurement organizations (OPO, $n = 57$) and local Hospital Commission for Organ and Tissue Donation for Transplantation (HCOdT, $n = 527$) [3]. These commissions coordinate referral of potential organ donors, enabling the diagnosis of brain death and organizing the organ and tissue donation and procurement process within the hospital. In addition, these commissions promote continuing medical education of regarding organ donation and transplantation. From 2010 to 2017, the number of potential donors increased by 52%, from 6979 to 10,629. The number of effective donors increased by 80%, from 1898 to 3415 (Table 1). Family refusal is relatively stable around 40% [3].

Recovered kidneys are allocated to patients registered in regional waiting lists with a median cold ischemia time around 24 h. The allocation system occurs within the same ABO group and is primarily based on points attributed to HLA A, B, and DR matching (Table 2). Among patients with similar HLA score, extra points are added according to time on dialysis or on the waiting list for preemptive patients (1 point for

Table 1 Kidney donation and transplantation

Parameter	2010	2017
Potential deceased donors, n	6979	10629
Potential deceased donors, pmp	36.6	51.6
Effective deceased donors, n	1898	3415
Effective deceased donors, pmp	9.9	16.6
Kidney transplants, n	4656	5929
Kidney transplants, pmp	24.4	28.8
Kidney transplants, living donors, n	1655	1136
Kidney transplants, deceased donors, n	3001	4793

the first year, 0.5 point for additional years to a maximum of 5 points), sensitization (4 points for PRA > 80%, 2 points for PRA of 50–79%), pediatric (4 points) and diabetic (3 points) patients. Importantly, all organs from donors younger than 18 years are primarily allocated to the pediatric population, regardless of the HLA compatibility. There are no dedicated waiting lists for high kidney donor profile index (KDPI) organs. Finally, maximal priority is given to patients without access for dialysis. In 2017, there were 21,059 adult and 418 pediatric active patients on regional waiting lists. Only in 2017, there were 10,565 new adult and 278 pediatric new patients in the waiting list [4••].

Kidney Transplantation

There are currently 131 transplant teams in the country. In 2017, there were 5929 kidney transplants (2nd highest in the world) [5•]. The number of kidney transplants increased by 27%, from 4656 in 2010 to 5929 in 2017. Contrasting with the world trend, the number of transplants with kidneys from living donors (1655 in 2010 versus 1166 in 2017) decreased while the number from deceased donors increased (3001 in 2010 versus 4793 in 2017). In 2017, there were 319 kidney transplants performed in the pediatric population, 289 from deceased, and 60 from living donors.

World Ranking and Geographic Disparities

Despite these recent relative improvements, correcting these absolute numbers to the Brazilian population reveals another

Table 2 Score points based on HLA donor/recipient compatibility

	0 mm	1 mm	2 mm
HLA A	1	0.5	0
HLA B	4	2	0
HLA DR	10	5	0

national reality. In 2017, the number of effective donors was 16.6 per million population (pmp, 23rd in the world) [5•] and the number of kidney transplants was 28.8 pmp (33rd in the world) [4••]. Of course, these figures should be analyzed considering the GDP per capita adjusted for purchasing power parity of US\$ 16,730 according to the International Monetary Fund (112th in the world).

As in any other country, Brazil has obvious disparities in transplant indicators. Differences in demographic density, gross domestic product, prevalence of patients with chronic kidney disease on dialysis and listed to receive a kidney transplant, and number of specialized professional members of the national transplant society are some of the key factors involved. In 2016, effective deceased donors ranged from 3.9 pmp in the North region to 34.1 pmp in the South region. Similarly, the number of kidney transplants ranged from 5.8 pmp in the North region to 49.2 pmp in the South region (Fig. 1) [3].

Kidney Transplant Outcomes

Currently, there are no national agencies evaluating transplant center performance. The Brazilian Organ Transplantation Society (*Associação Brasileira de Transplante de Órgãos e Tecidos*, ABTO) also does not mandate transplant centers to send outcome data on a regular basis. In 2017, only 46% of all transplant centers sent full data to ABTO for analysis. Based on this setting, graft survival has been improving over the last 10 years, although the data should be interpreted with caution given the wide geographical disparities.

Reimbursements

The treatments of the vast majority of patients with chronic kidney disease, including those on dialysis and kidney transplant recipients, are covered by the public Unified Health

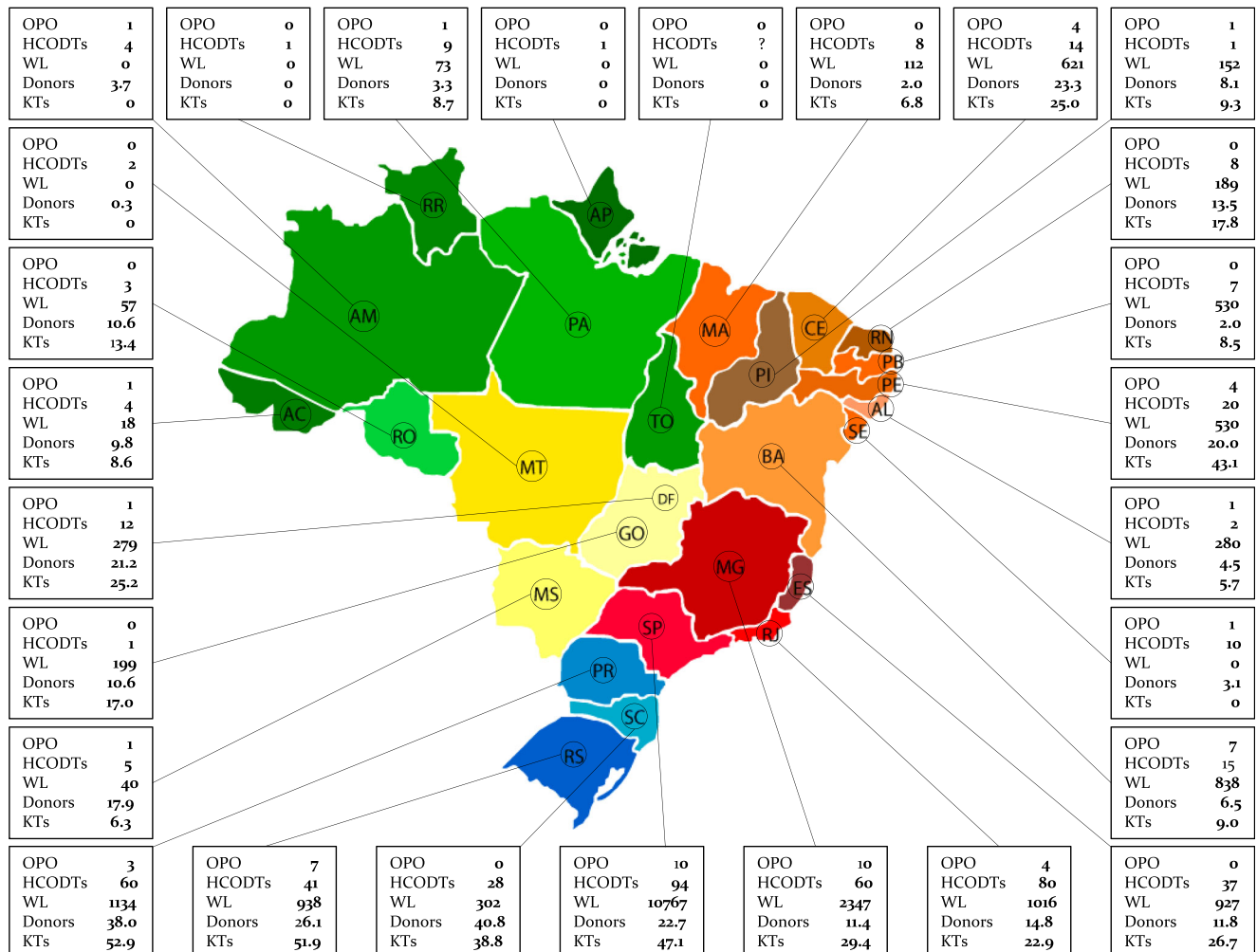


Fig. 1 Number of organ procurement organizations (OPO), Hospital Commission for Organ and Tissue Donation for Transplantation (HCODT), patient in the waiting list (WL), deceased donor per million

population (Donors), kidney transplants per million population (KT) in each state and Federal District

System, resulting in Brazil having the largest public kidney transplant program worldwide. Reimbursements are provided to every single step in the transplant process, including organ procurement, recovery and allocation, and hospital admissions, surgical procedures, diagnostic tests, medical appointments, and immunosuppressive medication.

The reimbursement for organ procurement is composed of the sum of several procedures carried out from the notification of potential donor till organ recovery. These procedures involve the clinical evaluation and complementary tests for brain death diagnosis, donor maintenance, and organ recovery. Immunogenetic tests, including HLA typing, PRAs, and crossmatches, are reimbursed following government-regulated fixed prices with no predefined adjustments over time nominal. Similarly, transplant centers receive fixed bundle reimbursements for each kidney transplant. This amount may be increased by up to 60% depending on the number and type of transplants performed in the same institution. Importantly, reimbursements are not corrected for patient complexity, immunological and non-immunological risks, immunosuppressive medications, duration of index hospitalizations, and any other incidental costs.

Opportunities for Future Improvements

This well-coordinated national public-funded program has several challenges for future interventions. Besides the need to continue to increase the number of potential donor notifications, using national campaigns and local educational strategies, the system needs to foment earlier notification after brain death, to reduce hemodynamic and metabolic instability, and the consequent high proportion of donors with acute kidney injury, given the increasing age and proportion of donors with high KDPI [5•]. Potential donor notifications come from small local hospitals with very limited human and structural resources. Increasing awareness is fundamental for earlier notification, and development of well-trained teams for donor maintenance appears to be the ideal strategy.

The allocation system, primarily based on HLA matching, precludes the maintenance of an adequate work-up for all potential recipients on the waiting list. Given the heterogeneity of transplant centers, the unpredictable clinical suitability of a potential recipient on the waiting list, and the relatively wide distances from the transplant center even under regional allocation system, cold ischemia time remains a significant challenge. Additionally, as there are no dedicated lists for high KDPI kidneys, the decision to decline or accept a kidney offer is taken by the patient only after organ allocation, after discussion with the local transplant nephrologist, further delays the transplant procedure.

Consequently, cold ischemia time tends to be even higher with offers of kidneys recovered from high KDPI organs due to sequential refusals by different transplant centers. Strategies are in place to reduce the ischemia time, including the use of virtual crossmatch, donor HLA typing and complement dependent cytotoxicity crossmatch using donor's peripheral blood, and predefined time to accept or decline one offer.

The combination of late referral, inadequate maintenance, and long cold ischemia time results in high incidence of delayed graft function. DGF is associated with increased hospital morbidity, delayed hospital discharge (due to socioeconomic conditions in Brazil, all patients are discharged only when they are free of dialysis), increased costs, and ultimately inferior long-term allograft function and survival [6]. The high incidence of delayed graft function, around 60–70% among recipients of deceased donor kidney allografts, influences negatively long-term graft survival [7]. Interestingly, although different rejection phenotypes are the leading cause of graft loss, infections account for the majority of death at any time in the transplantation follow-up, contrasting with findings in the USA, Europe, and Australia. Bacterial infections, primarily urinary infection and pneumonia, are the leading causes of death [8•].

The low prevalence of kidney transplant recipients with diabetes and several environmental risk factors are associated with infection complications such as lower socioeconomic conditions, lower health literacy, and higher prevalence of endemic diseases.

Finally, fixed bundle reimbursements that do not account for transplant risk and complexity, duration of hospitalization, and incidental expenditures are a growing concern as many transplant centers are developing risk-aversion strategies, limiting the number of transplants and avoiding high-risk patients. There is no payment to access the waiting list, regardless of whether the patient has only public or private insurance.

In summary, Brazil has perhaps the largest public kidney transplant program worldwide with still growing activities in all levels. Yet, several structural issues have been identified that will require coordinated strategies to allow further growth while increasing the long-term quality of care for an increasing, ageing, and complex population in need.

Compliance with Ethical Standards

Conflict of Interest The authors declare that they have no conflict of interest.

Human and Animal Rights and Informed Consent This article does not contain any studies with human or animal subjects performed by any of the authors.

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