Human Immunology 78 (2017) 9–15

Contents lists available at ScienceDirect

journal homepage: www.elsevier.com/locate/humimm

Old versus new: Progress in reaching the goals of the new kidney allocation system

Connie J. Wang MD [a], James B. Wetmore MD, MS [a], Ajay K. Israni MD, MS [a,b,*]

[a] Division of Nephrology, Hennepin County Medical Center, University of Minnesota, 701 Park Avenue, Minneapolis, MN 55415, United States
[b] Scientific Registry of Transplant Recipients, Minneapolis Medical Research Foundation, 701 Park Avenue, Suite S4.100, Minneapolis, MN 55415, United States

ARTICLE INFO

Article history:
Received 11 July 2016
Revised 29 July 2016
Accepted 11 August 2016
Available online 12 August 2016

Keywords:
Deceased donor kidney transplant
End-stage renal disease (ESRD)
Estimated posttransplant survival (EPTS)
Kidney donor profile index (KDPI)
Kidney transplant
New kidney allocation system (KAS)

ABSTRACT

As demand for kidney transplant continues to grow faster than organ availability, appropriate allocation of deceased donor kidneys is an acute priority. Increased longevity matching is central to this effort. To foster equitable and efficient utilization of deceased donor kidneys, a new kidney allocation system (KAS) was introduced in December 2014. Major achievements in the 1 year after its implementation include a reduction in age-mismatch and an increase in access to transplant for historically disadvantaged candidates, such as those with very high levels of panel-reactive antibodies or long dialysis duration. However, the rate of discarded kidneys has not decreased, and an increase in A2/A2B transplants has yet to be realized. Organs are now shared more often at the regional and national levels, with some regions experiencing an increase in transplants and other a decrease. While implementation of the KAS has been associated with the attainment of key goals, the kidney transplant community must remain vigilant about potential untoward consequences, including reductions in transplant rates for specific groups such as pediatric patients. More time is required before firm conclusions about the long-term effects of the new KAS can be rendered.

1. Introduction

Kidney transplant is associated with increased longevity and improved quality of life compared with maintenance dialysis in patients with end-stage renal disease (ESRD) [1]. These benefits are not confined to the most ideal transplant candidates, but extend to older patients and to those with diabetes, cardiovascular disease, and other comorbid conditions [2,3]. The combination of a trend toward less restrictive criteria for listing candidates for transplant and an increase in the prevalent dialysis population [4] has resulted in marked growth of the waiting list, which increased from ≈58,000 in 2004 to ≈99,000 in 2014 [5]. Unfortunately, over the same period, the availability of deceased donor kidneys increased only from ≈7150 to ≈8500, or by about 20% [6]. Thus, the shortage of kidneys, or "kidney gap," has become steadily larger.

The increasing kidney gap has given rise to twin challenges: to increase effective utilization of scarce organ resources by maximizing graft longevity and, simultaneously, to ensure equitable access to kidney transplant by reducing disparities in care. The former requires allocation of kidneys of higher quality to recipients projected to have a longer life span, while the latter demands that traditional barriers to transplant, such as high sensitization, unfavorable blood type, long dialysis duration, and geographic disadvantage, be reduced. The key principles underpinning optimal organ allocation policies are therefore utility and equity, and their roles within the conceptual framework of organ allocation have been reviewed previously [7,8].

To confront these twin challenges, the Organ Procurement and Transplantation Network (OPTN) Kidney Transplantation Committee approved a new deceased donor kidney allocation system (KAS) in December 2014, an effort more than a decade in the making. To improve utility, two new tools were created, the kidney donor pro-

Abbreviations: CIT, cold ischemia time; cPRA, calculated panel-reactive antibody; DGF, delayed graft function; ECD, expanded criteria donor; EPTS, estimated posttransplant survival; ESRD, end-stage renal disease; HLA, human leukocyte antigen; KAS, kidney allocation system; KDPI, kidney donor profile index; OPTN, Organ Procurement and Transplantation Network; SRTR, Scientific Registry of Transplant Recipients.

* Corresponding author at: Scientific Registry of Transplant Recipients, Minneapolis Medical Research Foundation, 701 Park Avenue, Minneapolis, MN 55415, United States.

E-mail addresses: connie.wang@hcmed.org (C.J. Wang), james.wetmore@hcmed.org (J.B. Wetmore), isran001@umn.edu (A.K. Israni).

http://dx.doi.org/10.1016/j.humimm.2016.08.007
0198-8859/

file index (KDPI) and the estimated posttransplant survival (EPTS) metric. The KDPI is a measure of deceased donor kidney quality, while the EPTS is an estimate of the recipient's life expectancy. Collectively, these tools are designed to address the problem of "longevity mismatch," which occurs when recipients with long projected lifespans are allocated kidneys of lower quality, or *vice versa*. Simultaneously, to improve equity, a new prioritization framework was developed that incorporates a revised point allocation system designed to increase access to transplant for disadvantaged candidates.

In this review, we present the early results of the new KAS and evaluate whether it has begun to meet its designated goals. Specifically, we discuss the impact of the new KAS on the transplant waiting list, organ utilization, kidney allocation, and graft outcomes, contextualizing these initial results within the overarching guiding principles of balancing utility and equity.

This review used data from the Scientific Registry of Transplant Recipients (SRTR). The SRTR data system includes data on all donors, waitlisted candidates, and transplant recipients in the US, submitted by the members of the OPTN. The Health Resources and Services Administration, US Department of Health and Human Services, provides oversight of the activities of the OPTN and SRTR contractors.

2. Waiting list

While the new KAS does not specifically seek to affect characteristics of the waiting list, its adoption could possible indirectly do so, perhaps adversely. We review the early evidence for how the new KAS may have affected waiting list characteristics, including center readiness, waiting list size, active status percentage, distribution of candidates by various demographic and clinical characteristics, and waitlist mortality.

Center readiness is defined by administrative compliance with data collection mandates upon which the implementation of the new KAS is dependent. Transplant centers must verify information required for calculation of the EPTS (a measure required, along with the KDPI, to facilitate longevity matching), calculated panel-reactive antibody titer (cPRA, a score permitting prioritization for highly sensitized candidates), and anti-A antibody titers (a test required to assess eligibility of B blood type candidates to receive kidneys from A2/A2B donors).

In preparation for implementation of the new KAS, center adherence to EPTS and cPRA reporting requirements increased rapidly, with the data required for EPTS and cPRA calculation and verification available for more than 90% of candidates [9]. Over the first 6 months after the new KAS implementation, the rates continued to increase, albeit slowly: the percentage of calculable EPTS scores eventually reached 98% and calculable cPRA values approached/exceeded 94% (Fig. 1). Unfortunately, information on blood type, essential for increasing transplant of A2/A2B blood type kidneys into B blood type recipients (thereby reducing the disproportionately long waiting times for such candidates) remains lacking: such information was available for only 4.0% of active candidates and 2.9% of all waitlisted candidates 6 months after implementation of the new KAS. This amounts to less than 600 of the 14,000 waitlisted B blood type candidates.

The total size of the kidney waiting list remained similar 6 and 12 months after implementation of the new KAS, ≈109,000, and the number of new registrations remained unchanged [9]. The percentage of waitlisted candidates with active status also remained constant, at ≈60%, at 12 months [10]. However, the distribution of candidate waitlist characteristics changed in certain respects. A year into the new KAS, there has been a substantial 13.0% reduction in candidates with dialysis duration 10 years or longer, and an 11.7% reduction in candidates with cPRA 99% or higher [11]. This may be a sign that the aims of new KAS are being realized: candidates with these traditional barriers to transplant are now undergoing transplant at a substantially higher rate than before, resulting in a decreased waitlist prevalence of high-cPRA and long-dialysis-duration candidates. In contrast, the distribution of demographic characteristics (age, race, and sex) and causes of ESRD are initially unchanged [10]. Given the small number of kidney transplants relative to the size of the waiting list, more long-term data are required before the effect of the KAS on these variables can be accurately assessed.

Waitlist mortality appears to have remained stable at 12 months [10], but it is too early to form definitive conclusions about the impact of the new KAS.

3. Kidney procurement and utilization

An important aim of the new KAS is to increase the procurement and utilization of what were previously known as expanded criteria donor (ECD) kidneys (colloquially termed "marginal kidneys"). While introduction of the KDPI makes the term "ECD" obsolete, kidneys considered marginal now correspond to those with KDPI scores higher than 85% (henceforth termed "high-KDPI kidneys"). More than 40% of such kidneys are discarded [12], and as such they represent a potentially valuable resource if they can be successfully matched to appropriate candidates. Whereas in the past such kidneys would typically have been shared only at the local level, the KAS now mandates sharing at the regional level in an attempt to decrease discard rates. Thus, implementation of the KAS could be expected to increase the procurement and utilization of high-KDPI kidneys.

To date, there is no evidence that procurement of high-KDPI kidneys has increased. While the procurement rate of all deceased donor kidneys increased by 4.0% in the first 6 months [9] and 6.2% in the first 12 months [10], the percentage of procured high-KDPI kidneys was unchanged. Likewise, utilization of high-KDPI kidneys did not improve. The overall discard rate (a measure of utilization) actually increased, in relative terms, by 9.7% at 6 months. This effect occurred for kidneys at all levels of KDPI, except for the best kidneys (those with KDPI < 20%); discard rates increased by 17.7% for kidneys with KDPI 21%–34%, by 10.3% for kidneys with KDPI 35%–85%, and by 11.3% for kidneys with KDPI higher than 85%. Beyond 6 months, interpretation of the data on discard rates is more complex. While data from an OPTN report suggest that 7–10 months after adoption of the KAS, discard rates for kidneys at all KDPI levels (including high-KDPI kidneys) are returning to pre-KAS levels [9], a study by Massie et al. reported that the odds ratio of discard for a kidney with KDPI higher than 70% increased by 29% at 9 months post-KAS implementation [13].

It may appear somewhat paradoxical that increased sharing has not, thus far, led to increased utilization of high-KDPI kidneys. While procurement rates of these kidneys are unchanged, utilization appears to be reduced. One possible explanation that should be investigated is whether high-KDPI kidneys are now being biopsied more often. Given that poor findings on procurement biopsy remain the most common reason for kidney discard, and that increased biopsy rates are associated, perhaps inappropriately, with increased discard rates [14], it is plausible that more high-KDPI kidneys are now being biopsied, leading to discarded organs.

In summary, while procurement rates have increased overall, procurement of high-KDPI kidneys has not. Discard rates for all but the best kidneys increased after implementation of the KAS, but may now be returning to pre-KAS levels. Thus, the long-term effects of the KAS on discard rates, and therefore on utilization, remain to be seen.