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Balancing Equity and Efficiency in Kidney Allocation: An Overview

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Abstract

Organs for transplantation are a scarce resource. Markedly, the transplant community's primary challenge is the stark disparity between the number of patients awaiting deceased donor organ transplants and the rate at which organs become available. However, the allocation of a limited number of organs poses another constant challenge: maintaining an equilibrium between renal transplant utility and equity, that is, striking a balance between the utilitarian argument of medical efficiency and the principle of equity. In this comprehensive overview, the authors delve into the challenge of maintaining an acceptable balance between equity and efficiency and elaborate on some of the factors that might inform a decisionmaker's evaluation of the extent to which a given allocation scheme is efficient or equitable.

Keywords: renal transplant; kidney allocation; medical efficiency; principle of equity

Introduction

There are several organ allocation systems used in various countries. They all call attention to the main challenge created by the scarcity of deceased donor kidneys: the need to balance equity with efficiency (medical utility).^{1,2,3} Put differently, each system, in its way, seeks to strike a balance between the utilitarian argument—the idea that each organ should be transplanted in the patient for whom it will last the longest⁴—and the principle of equity, which requires that each individual who could benefit from a transplant ought to have a comparable opportunity to receive one.⁵ The two principles are often in conflict yet can also converge, and the distinction between them is not always clear-cut. Moreover, it is not straightforward to measure the trade-off between efficiency and equity, as it is easier to quantify the former (e.g., according to recipient survival, years added to life compared to dialysis, kidney graft survival, quality of life, or averting the ineffective use of a scarce resource) than to quantify the latter. Even when quantification methods are available, it is difficult for decisionmakers to identify the measures that best capture the concepts of “benefit,” “efficiency,” and “equity,” which are poorly defined both in theory and in practice.⁶

Although efficiency and equity are technical terms with slippery meanings and complex applications, it is important to differentiate between them and not to showcase all the challenging traits under a unified list. Efficiency and equity are opposite and conflicting forces in a complicated and delicate system. Nonetheless, these contradictory traits must coexist; hence, it is essential to acknowledge them separately to understand the difficulty of finding equilibrium. In what follows, we elaborate on some of the factors that might inform a decisionmaker's evaluation of the extent to which a given allocation scheme is efficient or equitable. The “Efficiency Considerations” section specifies the efficiency considerations. We present the characteristics that challenge the utility trait and display health improvement measures, such

as quality-adjusted life-years (QALYs) and disability-adjusted life-years (DALYs). In the “Equity Considerations” section, we depict the equity considerations by emphasizing the factors considered to design equitable allocation policies. The “Suggestions” section offers suggestions that hold the potential to generate a fairer allocation policy. The “Summary: Efficiency versus Equity” section summarizes the trade-offs between efficiency and equity in kidney allocation policies.

Efficiency Considerations

Laws, rules, and regulations governing organ allocation formulate clear and explicit reference to the “best” use of organs in terms of waste reduction and avoidance and acknowledge the need to allocate organs under sound medical judgment. Yet, there is still substantial controversy regarding how much relative weight organ allocation schemes should give to each kind of benefit. For example, does utility indicate increasing the number of years lived posttransplantation? The amount of pain and suffering alleviated by transplantation? The number of lives saved by transplantation?^{7,8} Currently, decision-makers take the following characteristics into account when evaluating efficiency, although few features present a challenge to the efficiency trait.

Age

Exclusion from eligibility for transplantation based on age alone can arguably be considered unfair. Nonetheless, age is often used as a proxy for medical efficiency, given that life expectancy for older transplant patients is shorter than that for younger recipients. Thus, the “gain of years” that senior candidates can achieve from a transplant (compared to remaining on dialysis) is less than that for younger recipients. However, given that age demographics are shifting in developed countries, and older individuals are beginning to make up a more significant relative portion of the population, it seems likely that the conception that those over 60 years of age are “elderly” will progressively be challenged.^{9,10,11} In particular, the assumption that age is an adequate proxy for utility, and the idea that it is acceptable to refuse transplantation on the criterion of age alone, will no longer be valid.^{12,13}

Obesity

The prevalence of overweight and obesity at the time of transplantation has risen by 60% among kidney transplant candidates.¹⁴ Numerous studies^{15,16,17,18} have established a connection between overweight/obesity and significant comorbidities in kidney transplant patients. Among obese patients (i.e., body mass index [BMI] of ≥ 30 kg/m²), the rate of skin and soft tissue complications are enhanced, chiefly wound infections, wound dehiscence, and anastomotic and perinephric complications (e.g., lymphocele formation, hematoma, and vascular). Moreover, delayed graft function is higher, hence contributing to a longer length of stay following transplant. Systemic complications such as new-onset diabetes after transplant and cardiac outcomes also appear to be increased in the obese population. Therefore, elevated BMI in the setting of kidney transplantation has been linked with increased transplant-related complications, apprehensions about inferior rates of graft and patient survival, and higher transplantation costs.^{19,20} Owing to the aforementioned concerns, obese patients wait longer for kidney transplantation and develop increased morbidity while on the waiting list.^{21,22}

The practice and current guidelines concerning obese patients are relatively vague and tremendously flexible internationally, nationally, and sometimes even within the same department.²³ Thus, due to the correlated technical complexity, surgical complications, and outcomes-related worries, transplant programs may place restrictions on selecting obese patients for transplantation or can inflict a maximal BMI eligibility threshold for transplant.^{24,25}

With that said, observational studies and scientific evidence imply that transplantation among obese transplant patients poses survival advantages and improves life quality in contrast to wait-listed obese

transplant candidates.^{26,27,28} Furthermore, even though obesity negatively influences access to transplantation, current studies^{29,30} seem to support a neutral influence of obesity on the long-term graft and patient survival, and some even state that after transplantation, short- and long-term outcomes are quite satisfactory.³¹

To sum up, since it is hard to detect body composition restrictions that impede clinical gain from kidney transplantation, obesity should be treated as one risk factor and not be seen as an independent and additional obstacle for transplant listing. Yet, a nihilist point of view (i.e., listing everybody regardless of the degree of obesity) appears equally inept. Therefore, obesity should not constitute an utter contraindication or an exclusion criterion to transplantation; however, individualized risk assessment is required.^{32,33,34}

Diabetes Mellitus

Reduced recipient survival in preexisting diabetes mellitus, particularly type 2 diabetes, has been consistently reported. Death-censored graft survival is generally similar to other groups of patients, and the inferior result is ascribed to increased cardiovascular events. Nonetheless, the prognosis for diabetic patients on dialysis therapy is poor and remains a prominent risk factor for mortality.^{35,36}

Frailty

Frailty is present in up to 35% of patients with end-stage renal disease (ESRD). It is a condition distinct from comorbidity and disability, clinically expressed as reduced resistance to stressors and decreased physiologic reserve. Frailty is associated with falls, hospitalizations, poor cognitive function, poorer health-related quality of life, and mortality. Moreover, it is allied with inferior outcomes on dialysis and poor outcomes posttransplant, including delirium, delayed graft function, a longer length of stay, early hospital readmission, immunosuppression intolerance, and even mortality. Therefore, frailty is likely to be manifested in decreased access to kidney transplantation, even though some frail patients with ESRD can benefit from transplants over chronic dialysis. Hitherto, clinicians encounter difficulty identifying which patients are frail, whereas patients find it hard to report their frailty status accurately.^{37,38}

To conclude, frailty is associated with an inferior chance of listing, a lesser transplant rate, and higher wait-list mortality. However, it is a possibly modifiable candidate feature. It could be amended and optimized prior to transplantation (e.g., via prehabilitation and intensive exercise therapy), thus improving candidates' health.^{39,40,41}

FSGS Recurrence

Recurrence of focal segmental glomerulosclerosis (FSGS) in the allograft ensues in 30%–50% of patients and is associated with inferior renal allograft survival compared with patients transplanted for other causes of ESRD.^{42,43} It is the most common primary glomerular disorder in the dialysis population, with a prevalence of 4%.^{44,45} FSGS is the prominent factor of nephrotic syndrome in the adult population. It is labeled primary (i.e., idiopathic) when a precise cause cannot be detected or secondary due to various etiologies like genetic, viral-related, drug-induced, or adaptive. By and large, only primary FSGS recurs following kidney transplantation. The key risk factors for recurrence include younger age at diagnosis, rapid progression to ESRD (<3 years), race (reduced risk for blacks and Hispanics), and loss of previous allografts owing to recurrence. The medical hallmark of FSGS recurrence is proteinuria, which is usually diagnosed within hours to days after transplantation.^{46,47} Factors that are not associated with recurrence include human leukocyte antigen (HLA) mismatch, histologic subtype, time on dialysis, and immunosuppression type.^{48,49}

Despite progress and improvement in FSGS recurrence comprehension, kidney transplants' outcomes in patients with FSGS are still inferior to transplants for other causes of kidney disease. To date, novel insights into the pathogenesis of FSGS and its recurrence failed to change the outcomes markedly. Yet, plasmapheresis, high-dose cyclosporine, and rituximab are the most promising therapeutic options.^{50,51}

In summary, for the majority of FSGS patients, renal transplantation should be contemplated as the treatment of choice. Nevertheless, transplantation's success rate among these patients may be impaired due to the disease's common risk of recurrence on the allograft and inferior graft survival rate.⁵²

Medication Nonadherence

Nonadherence with medication is an intricate and multifaceted healthcare problem. Adherence is defined as the degree to which patients are capable of following the recommendations for prescribed treatments. Patients may be nonadherent during different treatment stages, whereas the reasons for deviation are diverse and may be intentional or unintentional.⁵³ In the realm of transplantation, patient adherence is critical for a positive prognosis. It incorporates a range of behaviors spanning from lifestyle changes to laboratory visits and routine attendance at clinics. Immunosuppressive therapy adherence denotes patients following the recommendations and instructions given by healthcare professionals.^{54,55} Since posttransplant adherence with immunosuppression is crucial to the transplant's success, nonadherence can result in considerable numbers of patients who fail to profit from the optimal benefit of transplantation; it may also be expressed in increased morbidity or even end with mortality.^{56,57}

Prudential Judgment

Additional measures of efficiency include predictions regarding patient survival, years added to life, or enhancement in life quality. Unlike predictions regarding graft survival, these predictions are left to clinicians' prudential judgment.^{58,59} In other words, these measures are dependent on the discretion of clinicians and transplant centers and are not strictly objective. As a result, the system may be vulnerable to manipulation, affecting its efficiency and the extent to which it is equitable.⁶⁰

When considering efficiency across different allocation policies, it is necessary to select an outcome measure that accurately reflects what the decisionmaker is trying to achieve. Since patients might ultimately benefit more from consideration, which seizes both quantity and quality of life, in the following subsection, we would like to elaborate on two measures that attempt to capture both of these qualities simultaneously.

Measures of Health Improvement

QALY

The QALY has served decades as a recognized health outcome metric.⁶¹ In general, it is a composite metric that takes into account both morbidity (quality of life) and mortality (survival). Grounded in decision science and expected utility theory,⁶² the QALY is based on the premise that people move through health states in the course of their lives and that each health state has a value ascribed to it. Health is defined as the value-weighted time—life years weighted by their quality—accumulated over the relevant time horizon. The general calculation of a QALY is $QALY = \text{Time} \times \text{Utility}$.

DALY

The World Health Organization uses the measure of DALY. One DALY can be perceived as one lost year of "healthy" life. The sum of these DALYs across the population, or the burden of disease, can be

considered a measurement of the disparity between current health status and an idyllic health situation in which the entire population lives to an advanced age, free of disease, and disability. DALYs for a disease or health condition are calculated as the sum of the years of life lost owing to untimely mortality in the population and the years lost because of disability for individuals living with the health condition or its outcomes.⁶³

Since both efficiency and equity are stated objectives of the organ allocation system, and because it is unfeasible to maximize these two outcomes simultaneously, perhaps, researchers should consider building a function, a measure of organ allocation. Namely, similar to DALY, which combines and scales morbidity and mortality, a metric that combines and measures the two outcomes of equity and efficiency should be developed.⁶⁴

Equity Considerations

There are numerous criteria for defining equity in organ allocation, where no approach is objectively superior to its alternatives.⁶⁵ In what follows, we elaborate on some of the factors taken into consideration in efforts to design equitable allocation policies. It is important to note that in Australia and the United States, social utility measurements are excluded from organ allocation ethics. That is, measures of societal benefit, economic productivity, or family cohesion have been ruled out as ethically justified criteria for organ allocation.^{66,67} The rationale for this decision is that considering these parameters might generate a slippery slope for decisionmakers and complicate an already delicate process.

Ancestry/Ethnicity

Non-Caucasian patients waiting for deceased-donor kidney transplants are simultaneously underrepresented in the donor pool and overrepresented (compared to the general population) in the ESRD population. This disparity, combined with allocation policies that emphasize HLA matching, leads non-white populations to be disenfranchised. Specifically, compared with Caucasians, non-whites endure longer waiting times before transplantation and are more likely to suffer other implications.⁶⁸ In the United States, for example, the disparity between blacks and whites manifests in the following ways: (a) after kidney transplantation, the graft survival rates among blacks are 10%–20% lower compared with those of any other ethnic group; (b) kidneys from black donors have significantly lower graft survival rates compared with kidneys from other populations, regardless of which ethnic group they are transplanted into; (c) blacks wait two times longer than whites do for kidney transplants; (d) the prevalence of ESRD in blacks is disproportionate to their representation in the population, because of their increased proneness to hypertension and diabetes, which is 2–4 times greater than that of whites; (e) compared with whites, blacks are referred later for kidney transplantation, are wait-listed later, and receive transplants later, irrespective of financial status^{69,70}; (f) the emphasis on HLA matching leads to racial inequity in the allocation system: the allocation schema is based on HLA antigens in North American whites,⁷¹ which have been well defined since the early 1980s⁷²; and (g) following transplantation, among patients treated with the immunosuppressive drug tacrolimus, blacks are two times more likely than whites to develop diabetes.⁷³

Biases of Healthcare Providers

Several researchers have claimed that blacks and other minorities are victims of institutionalized racism/sexism. Due to their ethnicity or gender, they have unequal, disadvantaged, or inferior access to transplants and the transplant waiting list. The argument stresses that race and gender matter and that these factors determine whether a patient will be referred to a transplant evaluation and affect his/her time on the waiting list.^{74,75}

Immunological Barriers

Candidates with high levels of panel reactive antibodies (>85%) have a much smaller pool of potential donors than those who are not highly sensitized and, subsequently, wait for prolonged periods for suitable grafts. To this end, pretransplant desensitization programs designed to remove donor-specific HLA antibodies have been proposed to enable transplantation in such individuals. However, these programs suffer from drawbacks in terms of both efficiency and equity. From a utilitarian perspective, this is not the ideal use of limited resources financially (it is a resource-intensive process) and organwise (nonsensitized patients can better utilize the organ). From an equity perspective, it may be considered unfair for sensitized persons to be prioritized.⁷⁶

Geographical Location

Within a specific country, patients located in different geographical regions may experience disparities in their access to transplantation and, particularly, in the ease with which they gain entry to the transplant waiting list and the extent of time spent there.⁷⁷ The combination of organs' varying degrees of viability and the proximity to the donated organ determines that the mere locale of one's residence or registration might outweigh medical needs or ethical assertions.⁷⁸ According to Dan Davis and Rebecca Wolitz,⁷⁹ this geographical preference is an elementary feature of current allocation systems design. It is not merely a "mishap" in the logical working of the allocation algorithm. Critics of this approach dispute the legitimacy of geography as a criterion for allocation, claiming that nonmedical criteria should not steer policy any more than a person's wealth, celebrity, religion, ethnicity, or race should (Donna E. Shalala's testimony on organ allocation before the U.S. Senate Committee in Davis and Wolitz⁸⁰).

Ability to Pay

The principle of equity is challenged by those whose socioeconomic status affords them opportunities to access transplants denied to persons of lesser status. In particular, such individuals may be able to "buy" organs from live donors. Some argue that this situation might be beneficial to wait-list candidates, as every live transplant removes an individual from the waiting list for a deceased donor organ, thus increasing the chances of those remaining in the pool receiving one.^{81,82}

In the United States, a particularly salient concern is that if an individual has no financial ability to pay for medication, they will be advised against transplantation. Individuals who do receive transplants and subsequently lose their insurance risk rejecting their grafts due to the inability to afford their medications.⁸³ These problems contradict the principle of equitable access to transplants.

Preferred Status

Some advocate that, as a matter of reciprocity and fairness, those willing to give organs (e.g., registered organ donors) should be given priority to receive organs, should the need present itself.⁸⁴ Supporters of this principle argue that, in addition to promoting fairness, offering preferred status to registered donors will have an equal attraction to rich and poor alike and might, therefore, mitigate economic disparities in access to organs. Opponents claim that it undermines the altruistic appeal of the act of donating a "gift of life" and, as a result, inhibits donation instead of encouraging it.⁸⁵ This concern would be particularly salient if preferred status were to outweigh other criteria for organ allocation decisions (a policy supported, e.g., by LifeSharers, a private organ donation network that operated for several years in the United States).⁸⁶ Critics (e.g., the United Network for Organ Sharing [UNOS]) suggest that if this factor is instituted as a primary criterion for allocation decisions, the system might go down a "slippery slope" of complicated calculations of prospective candidates' value and deservingness of treatment.⁸⁷

Blood Group O

Patients with blood group O have fewer ABO-compatible living donors⁸⁸ compared with patients of other blood groups. At the same time, blood group O donor kidneys are available to candidates of different blood groups. As a result, blood group O patients are disadvantaged in organ allocation systems: they accumulate on the waiting list, endure longer waiting times than other patients, and experience higher death rates. Furthermore, in comparison with patients of different blood groups, candidates with blood group O incline toward inferior long-term life and graft survival and, as a result, are at greater risk of being removed from the waiting list prior to receiving a transplant.⁸⁹ Petra Glander et al.⁹⁰ claim that longer waiting time on dialysis is the factor responsible for blood group O patients' inferior health status at the time of transplantation, leading to inferior long-term outcomes after transplantation. These observations suggest that blood group O candidates do not receive fair and equal access to transplantation.

Evidently, organ allocation systems worldwide took into consideration several characteristics that presented a challenge to the equity trait and revised their policies accordingly. For instance, in numerous allocation schemes, the categorization of kidneys for transplant is based on the identity of the blood types of the donor and of the recipient (i.e., $O \rightarrow O$ and $B \rightarrow B$).⁹¹⁻⁹² Moreover, transplant organizations strive to enhance equity in allocation by significantly increasing transplant opportunities for disadvantaged ethnic minorities and highly sensitized patients.^{93,94,95}

Suggestions

Unfortunately, this review elucidates that there is no consensus on how to develop an organ allocation policy that delivers maximum efficiency while ensuring utmost equity. Although there is a widespread agreement about each ethical guideline's importance, there is still a strong disagreement about putting all the parameters into practice. Perhaps, Daniel Reidpath et al.⁹⁶ were right, and the question asked should not be what is more vital, a kidney allocation policy that delivers equitable outcomes or one which is medical efficient? Rather, a question that inquires what is more significant to the lay public, organ allocation policy that provides equitable (fairly distributed) outcomes, or an approach that maximizes health gains? Therefore, in line with this perspective, we suggest paving the right path toward a more balanced allocation system depends on a broad and inclusive deliberation system. The inclusion of different stakeholders (e.g., the general public, patients, their families and carers, donor representatives, and healthcare clinicians)⁹⁷ who hold various ideas and viewpoints might yield a fairer and more representative system. In addition, we believe that key stakeholders are most likely to perceive an allocation system as efficient and equitable if the system takes into account those stakeholders' ideas regarding which criteria yield efficiency and equity.

Following this inclusive line of thought, maybe the trade-off problem should be addressed from a different aspect, for example, recipient choice. Building on prior knowledge and research, we would like to illustrate this point. Xuanming Su and Stefanos Zenios⁹⁸ argued that to understand the significance candidates attach to outcomes associated with transplant decisions, they should be asked to declare which types of kidneys they would be willing to accept when joining the waiting list, instead of stating their preference when they are offered a kidney (like existing systems). Whereas Jae-Hyeon Ahn and John Hornberger⁹⁹ concluded that engaging candidates in the selection process of optimal donor kidney hold the potential to improve candidates' quality and duration of life and consequently enhance kidney transplantation programs' overall efficacy. Amir Elalouf and Uri Yechiali (unpublished data) also state that candidates should be granted the opportunity to evaluate the benefit of accepting the first offered organ and comparing it to the efficacy of waiting for the next one. The authors' analysis suggests that, compared with other allocation policies such as first come first served or UNOS, the proposed rule offers superior performance in terms of equity (it is the fairest policy for waiting time) and medical efficiency. Hence, the notion that we are trying to portray is that a fairer system requires the public's involvement in the organ donation and allocation processes by sharing their preferences with decisionmakers. If donated

organs are a community resource and are regarded as a national, lifesaving means, guidelines, and principles have to represent and reflect the values and beliefs of the different layers comprising a community.

Summary: Efficiency versus Equity

It is inherently impossible to maximize efficiency (utility) and equity simultaneously; instead, there is a trade-off between the two ethical principles (illustrated in Figure 1). Indeed, addressing any one of the

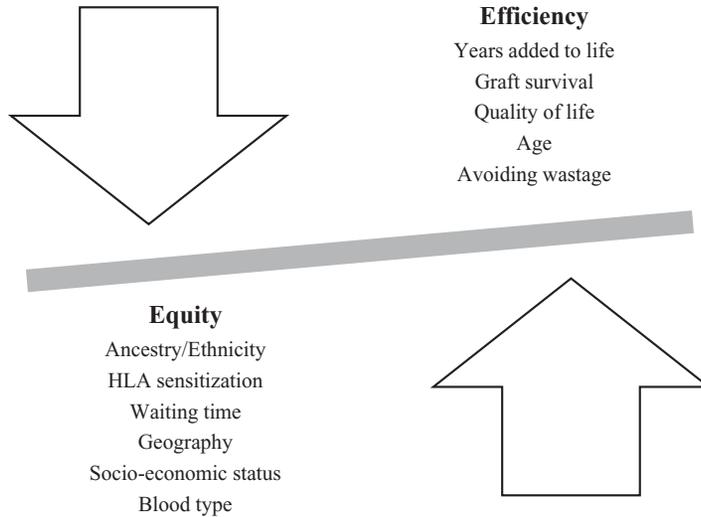


Figure 1. Balancing equity and efficiency.

Table 1. The Kidney Allocation System (KAS) in View of the Necessity to Balance Conflicting Ethical Principles^a

| Aims of the KAS | Ethical principle addressed |
|---|-----------------------------|
| 1. More precise estimation of graft and recipient longevity to increase the potential survival of the transplanted kidney 2. Providing adequate levels of access for patients on the waiting list | Efficiency/equity |
| Advancing posttransplant kidney function for patients with the longest estimated life expectancy (posttransplant survival) who are also the most likely to need another transplant due to the early age of ESRD onset | Efficiency |
| Reducing loss of potential functioning years of deceased-donor kidney grafts via ameliorated matching | Efficiency |
| Ameliorating offer system efficacy and organ use via the presentation of a new scale for kidney quality (KDPI) | Efficiency |
| Decreasing disparities in transplant access for populations, for instance, patients from racial/ethnic minority groups, pediatrics, and sensitized candidates | Equity |

^aFriedewald JJ, Samara CJ, Kasiske BL, Israni AK, Stewart D, Cherikh W, et al. The kidney allocation system. *The Surgical Clinics of North America* 2013;93(6):1395–406. doi:10.1016/j.suc.2013.08.007. The table was adapted to the current paper. Abbreviations: ESRD, end-stage renal disease; KDPI, kidney donor profile index.

challenges outlined above—including injustice stemming from age, ethnicity, geographical location, socioeconomic status, and so forth¹⁰⁰—is likely to impair the capacity to address others, thereby creating controversy and potentially inflicting some cost on autonomy, impairing trust, or reducing live donation.¹⁰¹⁻¹⁰² Thus, a righteous and fair organ allocation process that will satisfy all the community layers is still not in sight. Yet, policymakers generally agree on the criteria that should *not* be considered in organ allocation decisions, for example, arbitrarily deprioritizing certain groups merely since they are easily identifiable and distinguishable or because of their instrumental or societal value.¹⁰³ Hence, national allocation systems and local policies concerning the evaluation of potential recipients and acceptance of organs are designed to balance the various ethical (efficiency/equity) principles in a standardized and socially acceptable manner.¹⁰⁴ Table 1 summarizes how the kidney allocation system, which UNOS currently implements, attempts to address each principle.¹⁰⁵

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Notes

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