The New UNOS Lung Transplantation Allocation System


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Lung or heart-lung transplantation is an acceptable therapeutic option for patients with advanced lung diseases, including patients with pulmonary hypertension in whom all other therapies have been exhausted. However, the supply of donor lungs is scarce relative to the demand.[1] Among patients in the United States awaiting lung transplantation, unlike among those awaiting heart, liver, or kidney transplantation, priority for organs as they become available has been based on accumulated waiting time on the list, not on severity of illness or clinical status. Under the old system, donor lungs were allocated based on the time accrued while on the waiting list, after taking ABO blood type, size, and geographic location into consideration. Although this method of allocation is simple and appears to be fair, it can disadvantage patients who are sicker and/or have rapidly progressive diseases. The death rate of potential lung recipients on the waiting list is high and there have been observed differences in waiting-list mortality based on diagnosis.[1,2] Therefore, survival after transplantation in the older model could be suboptimal, resulting in a reduction in the number of lives saved, the number of years of life saved, and the quality of those lives.

In light of these concerns, and under a directive from the Department of Health and Human Services to the United Network for Organ Sharing (UNOS), a new lung allocation system has been developed and recently implemented.[3,4] The new system represents an attempt to improve on the previous lung allocation scheme by balancing urgency of need and likelihood of survival after transplantation, ensuring the optimal use of transplanted organs and the best possible outcomes for individual patients.

The Lung Allocation Score

The new system is based on a lung allocation score. All individuals in need of lungs who are over the age of 12 years will receive lungs on the basis of his or her lung allocation score. The higher the score, the greater the likelihood of being offered donor lungs. The lung allocation score is derived from multiple clinical variables. These clinical variables (**Table 1**) are used to calculate the following:

- The waitlist urgency measure (WLi), which predicts the number of days an individual with a specific set of characteristics is expected to live during the next year on the waiting list (range 0-365).
- The post-transplant survival measure (PTi), which predicts the number of days an individual is expected to live during the first year after the lung transplantation (range 0-365).

The raw allocation score is calculated using the following equation:

$$\text{Raw Score} = \text{PTi} - 2\text{WLi}$$

The raw score can range from –730 to 365. A final lung allocation score (0-100) is obtained by normalization of the raw score.

$$\begin{aligned}\text{Lung Allocation Score} &= 100[\text{Raw Score} - \text{minimum}]/\text{Range} \\ &= 100[\text{Raw Score} - (-730)]/1095 \\ &= 100[\text{Raw Score} = 730]/1095\end{aligned}$$

Under this system the clinical variables listed in **Table 1** need to be updated once every 6 months in transplantation candidates, but can be updated more frequently at the discretion of the transplantation center.

Impact of the New Lung Allocation System on Pulmonary Hypertension Patients

It is unclear how the new lung allocation system will impact patients with pulmonary arterial hypertension without or with congenital heart disease (Eisenmenger syndrome). It is also not known how patients in need of combined heart-lung transplantation will fare under the new system. In addition, the lung allocation system does not account for clinical events such as hemoptysis or syncope, generally accepted poor prognostic factors in pulmonary hypertension. In cases where the transplantation center feels that an individual's lung allocation score underestimates his or her clinical severity, an appeal can be made to a lung review board for adjustment of the score. Thus, although the new system

Table 1. Clinical Variables Used for Lung Allocation Score Calculation.

Characteristics for Waiting List Model	Characteristics for Post-transplant Model
Age (years)	Age at transplant (years)
Body mass index (kg/m^2)	Creatinine at transplant (mg/dL)
Diabetes	New York Heart Association functional class
New York Heart Association functional class	Forced vital capacity for groups B and D (% predicted)
Forced vital capacity (% predicted)	Pulmonary capillary wedge pressure mean ≥20 mm Hg for group D
Pulmonary arterial systolic pressure for diagnosis groups A, C, and D	Mechanical ventilation
Oxygen requirements at rest (L/min)	Diagnosis groups*
Six-minute walk distance (feet)	Diagnosis detailed**
Continuous mechanical ventilation	
Diagnosis groups*	
Diagnosis detailed**	

* Diagnosis groups
A = Obstructive lung disease
B = Pulmonary vascular disease
C = Cystic fibrosis or immunodeficiency disorder
D = Restrictive lung disease

** Diagnosis detailed
Bronchiectasis
Eisenmenger syndrome
Lymphangioleiomyomatosis
Obliterative bronchiolitis
Pulmonary fibrosis, other
Sarcoidosis and pulmonary arterial pressure mean >30 mm Hg
Sarcoidosis and pulmonary arterial pressure mean ≤30 mm Hg

introduces greater uniformity across transplantation centers, it does not replace the need for centers to exercise clinical judgment regarding the need for and timing of transplantation in individual patients.

The old system of selecting patients for lung transplantation required that physicians identify the "transplant window," the time when a patient is sick enough to warrant lung transplantation yet well enough to survive the transplant operation, and this still holds true. Under the new system, the burden of factoring in nonclinical decisions such as waiting time has, presumably, been eliminated. Ideally the new lung allocation algorithm will reduce variability among various centers as to the severity of the illness of patients who receive transplantation thus improving the fairness of the system.

A potential limitation of this new algorithm is that it has not been prospectively validated.[6,7] However, the UNOS plans to update this algorithm every 6 months using the most recent 3-year cohort of patients on the waiting list and lung transplant recipients. In conclusion, the need for change in the way donor lungs are allocated in the United States has been recognized and undertaken. It is hoped that this new system will optimize the utilization of this precious resource. Its impact on specific patient groups, including patients with pulmonary hypertension, remains uncertain. Because the system is being implemented in the absence of prospective statistical validation, and in view of rapid advances in nontransplant treatments for advanced lung diseases, frequent reassessment of the process will be critical.

References

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