



Mitigating the Impact of Socioeconomic Status on Listing for Lung Transplantation in Cystic Fibrosis

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It is with great interest that we read the paper in this issue of *AnnalsATS* by Lehr and colleagues (pp. 1384–1392) on socioeconomic factors and their effect on patients with advanced cystic fibrosis (CF) lung disease being placed on the lung transplant waiting list (1). They found that patients with CF with factors associated with worse socioeconomic status are less likely to be wait-listed for lung transplant compared with patients with CF with fewer or no such factors, irrespective of the severity of their lung disease (1).

The manuscript uses two large databases, the Cystic Fibrosis Foundation Patient Registry and the Scientific Registry of Transplant Recipients. This approach has the advantage of having more complete data and complementary data elements capturing clinical and socioeconomic factors. For example, Scientific Registry of Transplant Recipients has much better information on patients being wait-listed

(2), whereas the Cystic Fibrosis Foundation Patient Registry can identify patients who might not even have been referred to transplant and are used as control subjects (3). The authors employed a unique approach, for this scientific field, to assess the effect of socioeconomic factors and clinical factors together, assessing the effect of each while controlling for the other. In practice, it is also easier to quantify the effect of socioeconomic and clinical factors by counting them. The analysis was well done, and it showed that patients with CF and significant socioeconomic barriers have half the chance of being listed for lung transplant for the same degree of clinical illness (1). As expected, patients with CF with more severe illness were more likely to be listed than healthier ones, which is reassuring for our CF and transplant practices (1).

One of the interesting aspects of the paper is the effort to identify a threshold effect for the socioeconomic and clinical factors and when they start to truly influence the decision to list patients with CF (1). Identification of a threshold can help providers recognize patients with CF who are at high risk for being excluded from the lung transplant waiting list because of socioeconomic issues. It will also help in the design of future research, which can assess modification efforts of socioeconomic risk factors and whether such efforts can lead to increased placement on the transplant waiting list.

Solid organ transplantation provides a unique situation, in which the scarcity of the resources (organs) is acutely evident and a decision to list a patient might deprive another patient with a better chance of survival benefit from an organ transplant. Socioeconomic factors can affect post-transplant survival, so they affect patients seeking transplant both before and after transplant (4, 5).

As a large database study, there are limitations that are inherent to this type of analysis. The data are not granular enough to be absolutely certain that matched patients had the exact level of severity of illness as assessed by their healthcare teams. In addition, factors such as hypercapnia, which can have an effect on survival, were not able to be included, and other factors such as the presence of nontuberculous mycobacteria in the sputa of patients with CF were excluded because of a large amount of missing data (6). Another example is the use of ZIP code income as a surrogate for individual income, which has limitations as the authors acknowledged (7). The U-shaped relationship of distance from the center as a barrier for being placed on the lung transplant waiting list is another more difficult factor to explain. In addition, we do not know what factors led to patients being excluded from the waiting list. A decision not to pursue listing could have been made by the referring programs (by not referring patients to transplant centers), transplant programs, or patients themselves because of the social and financial requirements of lung transplant wait-listing. Identification of the reasons is important as we attempt to improve on wait-listing patients with CF who clinically need it. Another issue that could not be assessed is whether poor socioeconomic status led to worse understanding of the risk and benefits of lung transplantation, leading patients to refuse listing. Although all these issues do not change the conclusions of the article, they do have implications for future efforts to address inequalities in listing based on socioeconomic status. Categorizing socioeconomic factors as binary (present or not) in this manuscript has the advantage of simplicity, but it also has certain disadvantages, as it does not allow to more accurately assess the relative effects of each

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factor on the outcome of interest. The ability to better define individual effects of factors would be important for the design of interventions to overcome socioeconomic barriers.

Another interesting question, which was not in the scope of this manuscript, is on outcome assessment of patients with CF who were wait-listed versus not, including survival to transplant and overall survival; these are outcomes that most patients, families, and clinicians are truly interested in. A unique aspect of the study by Lehr and colleagues is that it studied patients with CF in the United States, a country that is somewhat unique in the developed world because of its lack of universal health insurance, and the socioeconomic inequalities tend to be more magnified than other similar countries (8). Replication of the current study's findings in another country or groups of countries would be very interesting and provide unique insights into the importance of

socioeconomic factors in leading to differential waiting-list rates among patients with CF.

The study by Lehr and colleagues is the next addition to a long list of studies examining the effect of poor socioeconomic status on outcomes in patients with CF and advanced lung disease. Prior studies demonstrate that poor socioeconomic status can lead to fewer referrals for transplant (9, 10) and lead to worse outcomes for nutrition and lung function (11). In other lung diseases, minority patients with idiopathic pulmonary fibrosis or chronic obstructive pulmonary disease on the lung transplant waiting list are less likely to survive to transplant (12, 13). In another thought-provoking article exploring survival differences between Canada and the United States in patients with CF, the presence of Medicaid or Medicare insurance had a detrimental effect on survival for patients in the United States, even though these

programs offer services that have similarities to the Canadian universal health insurance system (14); this is possibly another sign of poor socioeconomic status influencing outcomes in CF.

In conclusion, there are now multiple studies that have demonstrated the importance of socioeconomic factors in access to health care and outcomes in many different diseases, including CF. The next challenge for the medical community is to go beyond identifying socioeconomic issues as barriers for access to health care, procedures, or events such as getting on a lung transplant waiting list. It is our responsibility to disentangle each one of the barriers and subsequently attempt to intervene in a meaningful way to mitigate issues that lead to the inequalities based on socioeconomic status. ■

Author disclosures are available with the text of this article at www.atsjournals.org.

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