Commentary: Evaluating the Efficiency of Organ Procurement

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Meeting the increased demand for solid organs has emerged as a new challenge for transplantation. Advances in surgical technique, organ preservation, and anti-rejection therapy have made transplantation a life-saving option for thousands of patients. The care of patients with advanced chronic illnesses has also improved such that the number of potential recipients of solid organs has far outgrown the supply. For example, the number of transplantable kidneys has increased at a rate of 1.6 percent per year whereas the number of patients on the cadaveric renal transplant list increased 2.5-fold over the past decade (United States Renal Data System 1998 Annual Report). Examination of the current organ procurement process and its efficiency is the first step toward maximizing organ supply.

The organ procurement process is coordinated by Organ Procurement Organizations (OPOs), each with a designated service region. OPO involvement starts with a referral from a healthcare provider for evaluation of a potential donor. The procurement team assesses the eligibility of the potential donor, approaches the family for consent, and then organizes the retrieval and mobilization of organs. Community education and the fostering of relationships with practitioners in the hospital who initiate referrals, are two vital activities of OPOs that can affect the number of organs recovered.

Traditionally, the Health Care Financing Administration has assessed the performance of OPOs by measuring donor rates per million. However, the Association of Organ Procurement Organizations (AOPO) considers this performance evaluation to be a rough and potentially misleading representation of an OPO's effectiveness. Geographical variations in the demographics of donors and recipients, donor criteria, prevalence of chronic viral infections, cultural and racial variation in attitudes toward donation, use of advanced directives, and effects of population density contribute to difficulties in interpreting simple performance comparisons. The OPO must select from among a cohort of potential donors in order to yield suitable organs for transplantation. Three components of performance present challenges for an

OPO that require unique resources and skills at each step: (1) identifying possible donors, (2) achieving family consent for the subgroup of those deemed suitable, and (3) surgically retrieving organs for transplantation. Although donation rates represent the overall effectiveness of a procurement system, they do not capture the effectiveness of the OPO at each crucial step in the process.

Expanding performance analysis to include utilization of resources improves on donation rate comparisons. A variety of statistical and economic techniques are available for more complex assessments. Standard analytic techniques, such as statistical regressions or least squares estimates, show how the distribution of one variable is affected by another and are useful for predicting the output of a system with a given set of inputs. Regression analyses, which rely on the mean and standard error of each input and draw an imaginary line through the middle of multidimensional clusters of points, have not been used extensively to evaluate transplantation programs. A relatively new analytic tool for economic efficiency modeling is data envelopment analysis (DEA). Developed in 1979 by Charnes, Cooper, and Rhodes, DEA has found applications in evaluating the relative efficiency of not-for-profit organizations, governmental units, and health services (Charnes, Cooper, and Rhodes 1979). DEA relies on the most efficient units in a data set by "enveloping" them, and it draws an imaginary line around the optimal points called the "efficiency frontier." Each service unit is then compared with the benchmark units on the frontier and given an efficiency score. Adjustments for factors, such as size and volume of activity, can be built into the model as well. The advantage of DEA over regression techniques is that it generates information for each inefficient unit that may suggest which inputs can be reduced or outputs increased to improve overall efficiency.

The study by Ozcan, Begun, and McKinney in this issue evaluates the relative efficiency of OPOs in the United States using DEA. Based on a data set built from a nationwide survey of executive directors of OPOs and secondary data from the AOPO and the United Network for Organ Sharing, the model identifies an efficiency frontier from a set of OPOs with optimal performance. Production of the OPOs was represented by two outputs: kidneys recovered and extrarenal organs recovered. Available resources of the OPOs were represented by four inputs concerning hospital development activities. The first input is an index of hospital development that incorporates a hospital

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development director, a transplantation department, and written standards for effectiveness. The other inputs include fulltime equivalent hospital development staff, other labor, and non-hospital development operating expenses. For this model, the number of referrals was considered to be independent of an OPO's activity, yet important for the efficient procurement of organs; the authors included it as a nondiscretionary variable.

This study brings important features to the discussion of OPO efficiency and demonstrates the use of DEA in efficiency modeling. DEA has the advantage of identifying the changes required in the inputs or outputs to bring an inefficient OPO to the efficient frontier. For example, the efficiency score may suggest that an OPO has higher operating expenses than the optimally efficient OPOs; hence, this OPO might look to trim its operating budget. Limitations of this study arise from the selection of inputs and the application of efficiency scores to eventual improvement. Inputs should be representative of the requirements for a functional OPO, and ideally they should be appropriate targets for efficiency initiatives. Similarly, other limitations include choice of referrals as a nondiscretionary input (i.e., not controlled by an OPO). Referrals ultimately may not be nondiscretionary, given that one of the goals of OPOs is to increase referrals through increasing public and professional awareness of organ donation. This situation may soon be altered by legislative action. Under new Medicare regulations, hospitals have one year to achieve mandatory referral of all potential donors.

Unraveling OPOs' performance with respect to each other and under the constraints of local resources may help redirect efforts to promote efficiency models. For instance, the transplantation community widely accepts that socio-cultural beliefs and attitudes are perhaps the biggest impediment in obtaining family consent for donating organs; this especially affects the growing proportion of minority patients awaiting kidney transplantation. Specialized research techniques will need to be developed to describe these issues, implement improvement initiatives, and evaluate progress of the individual OPOs. Future endeavors in efficiency modeling may benefit from the involvement of directors of OPOs and transplantation programs in helping to define meaningful inputs within the scope of transplantation. A study currently under way by the AOPO is reviewing every death in patients age 70 years and younger, tracking referral and consent rates, and ultimately following the organs to their eventual transplantation. This study may highlight challenges and point to important inputs for modeling.

Expansion of the concept of efficiency to include the overall management of chronic diseases may also yield important information on the allocation of healthcare resources. Taking kidneys as an example, nontransplant, life-sustaining modalities in the form of chronic dialysis for patients with end-stage renal disease are among the most resource-intensive treatments available, and generally cost between $60,000 and 80,000 per year (United States Renal Data System 1998 Annual Report). Because artificial livers, hearts, lungs, and so on are generally not available, the chronic, preterminal phase of illness for patients needing these organs is shortened and, hence, consumes fewer resources. The standards of efficiency may be different for hearts, compared to kidneys, because of the limited options available for cardiac patients and the potential of an extended life span with dialysis. Modeling the cost efficiency of transplantation and OPOs in the context of chronic disease may help direct resources to achieve maximum benefit for patients and society. The impact of legislation on organ transplantation and public health is another important area of investigation.

Ultimately, the successful application of a model rests in its ability to describe current patterns, highlight areas of weakness, and lead to improvements. The study by Ozcan, Begun, and McKinney is an important step at evaluating the organ procurement process in terms of resources and their efficient utilization. Continuing research in this area will increase the availability of life-saving treatment to those with few remaining options.

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